PB80-209786

Proposed Sewerage Facilities in the Marion County Lake Improvement District Marion County, Kansas

(U.S.) Environmental Protection Agency
Kansas City, MO Region VII

Apr 80

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Prepared in cooperation with Sverdrup and Parcel and Associates, Inc., St. Louis, MO.

The Draft Environmental Impact Statement examined five alternatives for the improvement of sewerage facilities in the Marion County Lake Improvement District, Marion County, Kansas. The environmental, social, and economic impacts of each of these alternatives were evaluated, along with appropriate mitigation measures.

KEYWORDS: *Environmental impact statement-draft, *Sewage treatment, *Kansas.

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Region 7
324 East Eleventh St.
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April, 1980

EPA

Environmental Impact Statement

Draft

Proposed Sewerage Facilities Marion County Lake Improvement District Marion County, Kansas

REPRODUCED BY
NATIONAL TECHNICAL
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SPRINGFIELD, VA. 22161

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

For

PROPOSED SEWERAGE FACILITIES

in the

MARION COUNTY LAKE IMPROVEMENT DISTRICT

MARION COUNTY, KANSAS

Prepared by

U.S. Environmental Protection Agency, Region VII

Kansas City, Missouri

With Technical Assistance from Sverdrup & Parcel and Associates, Inc.

St. Louis, Missouri

Abstract: This Draft Environmental Impact Statement examined five alternatives for the improvement of sewerage facilities in the Marion County Lake Improvement District, Marion County, Kansas. The environmental, social, and economic impacts of each of these alternatives were evaluated, along with appropriate mitigation measures.

Comments should be submitted to this office within 45 days of the date the EPA's Office of Federal Activities publishes notice of availability of the EIS in the Federal Register.

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Date

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EXECUTIVE SUMMARY

1. Background

The Marion County Lake Improvement District was awarded a grant from the U.S. Environmental Protection Agency (EPA) to plan sewerage facilities for the District, which presently has no public sewerage system. As a result of that grant, a Facility Plan was completed proposing a conventional sewage collection and treatment system to serve the entire planning area. To consider the potential effects of that plan, and to examine alternative methods of solving possible water quality problems at the Marion County Lake, EPA has prepared this environmental impact statement.

2. Setting

The Marion County Lake Improvement District (LID) is a small residential community surrounding the 150 acre lake, and is located approximately 2.4 miles southeast of the City of Marion in central Kansas. The planning area encompasses about 925 acres and contains approximately 67 permanent homes, 99 seasonal homes, and 56 trailers occupied seasonally or on weekends.

This development nearly surrounds the lake, although it is separated from the shoreline by county park land and Lake Shore Drive. The outlying portions of the planning area are devoted almost exclusively to cattle grazing. The general atmosphere is one of a small, quiet retirement community focused on the recreational resources of the lake and the county park. Park facilities include a boat-launching ramp, fishing dock, swimming beach, and limited picnic and camping facilities.

Population ranges from about 145 persons during the winter to about 670 during summer months. On holiday weekends, campers can bring the total to nearly 1700. The average day population is expected to increase about 40 percent over the 20-year planning period, although in absolute terms this amounts to an increase of only about 150 persons.

Present sewerage facilities consist entirely of on-site systems. There are approximately 150 septic tanks, 17 holding tanks, and 20 privies on private property around the lake. There are also several holding tanks and a septic tank system serving the various county park facilities. Because local soils are poorly suited for septic tank leach fields, and because lot sizes are generally quite small (many of the originally platted lots are less than one-eighth of an acre), there have been several failures of septic tank systems in recent years. These failing systems have been either repaired or replaced by holding tanks.

In 1973, the County instituted a Sanitary Code which now prohibits the installation of septic tank systems on lots smaller than one acre, or where the soil percolation rate is less than one inch per hour. This ordinance has stopped the proliferation of inadequate septic tank systems, but does not apply to units installed before 1973.

3. Proposed Project

The Facility Plan developed by consultants to the Lake Improvement District analyzed several alternative ways to improve sewerage facilities in the planning area. The project selected includes a conventional gravity collection system and a force main to the City of Marion's proposed treatment plant. This plant is presently being designed under a separate federal grant and is not a subject of this EIS. The district would enter into a cooperative agreement with the City to pay a proportional share of the construction, operation, and maintenance costs of the plant. The plant will be a 0.5 MGD oxidation ditch, located west of the landing field. Discharge of the treated effluent will be to a small tributary of the Cottonwood River.

The collection system would consist of nearly 13,000 feet of 8-inch sewer pipe and approximately the same length of small-diameter force mains. This system would almost completely encircle the lake and would serve all existing development. Most of the collection lines, as well as the 10,000 feet of force main to the treatment plant, would be located in existing road rights-of-way. The collection lines have far greater capacity than would be necessary for the projected population at the lake because Kansas regulations do not allow gravity sewer pipes less than 8 inches in diameter. The construction cost of this system is estimated at $830,000.

4. Alternatives

Concern over the potential adverse economic impacts on local residents and the potential secondary impacts from induced development led EPA to explore other alternatives for sewerage facilities for the Marion County Lake area. As part of this analysis, more refined population projections were developed which significantly reduced the size of the project. Because of this reduction, the Facility Plan proposed project and the total retention lagoon alternative were re-analyzed to determine if the relative cost-effectiveness of these alternatives would be affected. A new on-site systems alternative was also developed that would involve the repair or replacement of failing septic tank systems with holding tanks and the purchase of a pumping truck to service all the holding tanks in the LID. The alternative of taking no federal action was also examined in detail. In this case, it was assumed that septic tank systems failing in the future would either be repaired or replaced by holding tanks, and that all new development would comply with the existing sanitary code.

A number of other possible alternatives were also screened to see if any merited further analysis. These included pressure sewer and vacuum sewer collection systems and community leach fields serving clusters of individual septic tanks.

5. Water Quality Investigations

As a part of this EIS, EPA conducted a series of water quality investigations to determine present conditions at the lake and to provide a basis for an assessment of the water quality impacts of each of the alternatives. Water samples taken from 85 wells in the area were tested for total coliforms, fecal coliforms, and nitrates. A septic leachate survey was conducted along the entire lakeshore to detect insufficiently-treated septic tank effluent entering the lake. An infrared aerial survey of the area was also conducted to detect septic tank leach field failures.

The results of these tests indicate that there is not a serious water quality or public health problem at the Marion County Lake. The infrared aerial survey indicated only three possible septic tank leach field failures, while the septic leachate survey detected no septic leachate plumes entering the lake. Most nutrients entering the lake are believed to be borne in runoff from cattle grazing areas in the lake's drainage basin. Well water samples found only two readings above the national drinking water standards for nitrates, and four positive readings for fecal coliforms.

6. Conclusions

Since no significant existing water quality problems could be identified, EPA has determined that the proposed project is ineligible for federal assistance under the Construction Grants Program of the Clean Water Act of 1977. Those few problems that were detected can be corrected with local resources and within existing local programs, as has been done since the passage of the County Sanitary Code.

There are several actions that local interests could take to improve the operation and reliability of their on-site systems. These include more thorough inspections of the systems and programs for reduction of water use. To reduce holding tank pumping costs, the residents at the Lake could use existing hydraulically-overloaded leach fields for grey water disposal and holding tanks for black water if they can demonstrate to the County Sanitarian that no public health hazard would result. The Lake Improvement District could also elect to construct the proposed project entirely with local funds, although this would be quite expensive for the local residents.

7. Public Participation

The first major public involvement in the proposed project was the public hearing on the Facility Plan, held on June 14, 1979. Most statements made supported the Facility Plan project. At the commencement of the EIS process, a public workshop was held at the Marion County Lake Meeting Hall, on September 8, 1979. This meeting was attended by nearly 150 local residents, and included a presentation on the EIS process and the project alternatives under consideration. Since that time, EPA and EIS preparation team personnel have had numerous informal discussions with local residents and public officials.

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NOTE

Bibliographic references appear in the text of this document as arabic numerals in parentheses, thus: (1). These citations appear in numerical order in the REFERENCES section in the rear of the document.

Technical words, phrases, and abbreviations appearing in this document which may be unfamiliar to the layman are defined in the GLOSSARY section, which immediately precedes the Appendices.

I INTRODUCTION

The United States Environmental Protection Agency (EPA) is considering grant awards to the Marion County Lake Improvement District for the design and construction of sewerage facilities at Marion County Lake and Park, Marion County, Kansas. This environmental impact statement (EIS) assesses the potential impacts of those grant awards on the social, economic, and biological environment of the planning area.

A. DESCRIPTION OF THE PLANNING AREA

Marion County Lake is located in Marion County, Kansas, approximately 140 miles southwest of Kansas City, and 50 miles north-northeast of Wichita. The lake lies about 2.4 miles southeast of the City of Marion, the county seat. Figures 1 and 2 show the location of Marion County and the planning area.

The 150-acre lake serves as the focus of a recreation and retirement community for approximately 145 persons year-round. During the summer, the resident population increases to approximately 670, and campers at the County Park surrounding the lake swell the population to over 1700 on holiday weekends.

Present development consists of approximately 67 permanent homes, 99 seasonal homes, and 56 seasonal trailers around Lake Shore Drive. Inside this road is County park land, with limited facilities for camping, picnicking, and fishing. Beyond the developed area lie rolling grasslands used for grazing cattle. The planning area encompasses a total area of approximately 925 acres.

B. PROJECT HISTORY AND DESCRIPTION

1. Legislative Background

The Clean Water Act of 1977 (PL 95-217) provides for restoring and maintaining the integrity of our nation's waters. Realizing that

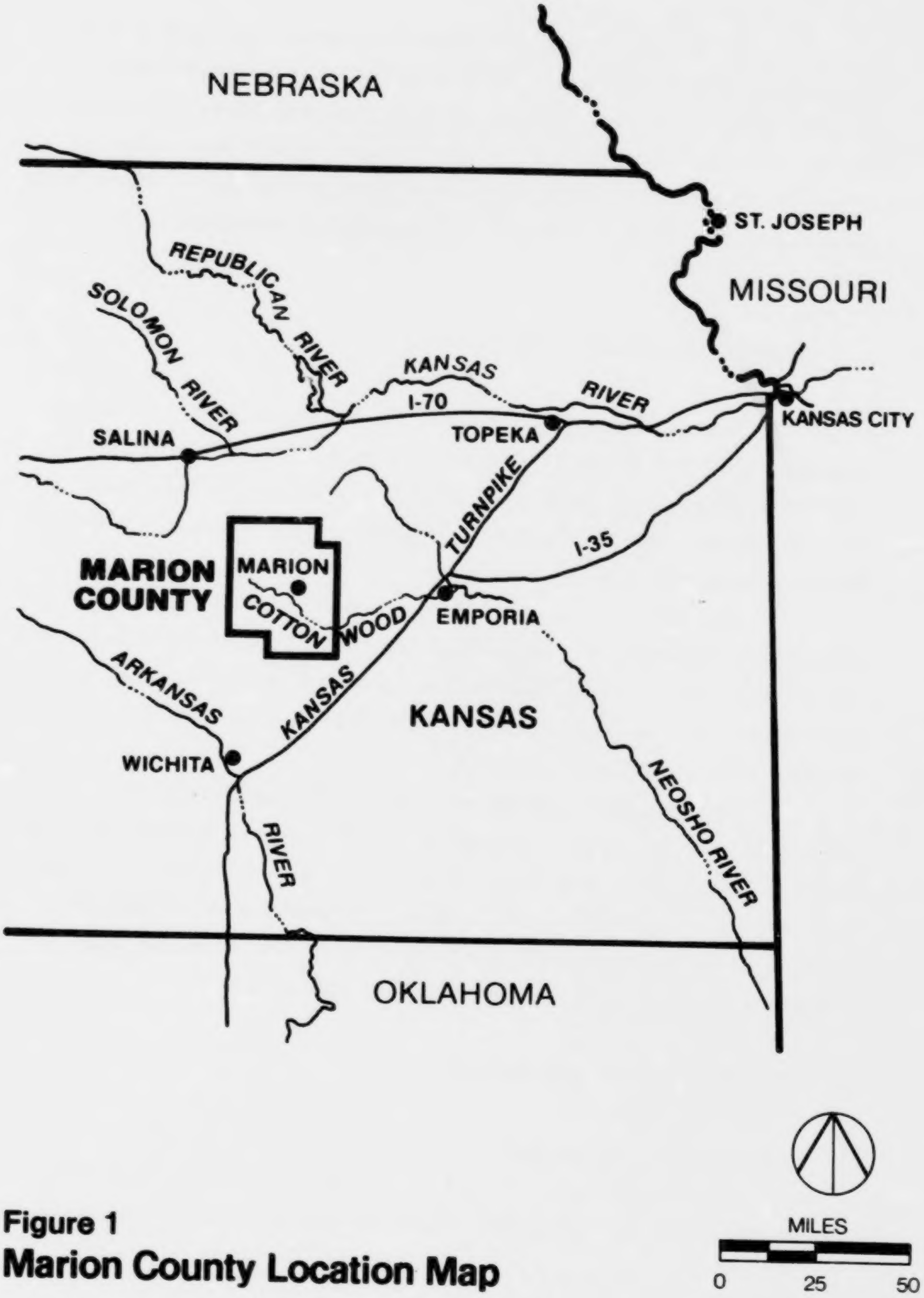


Figure 1
Marion County Location Map

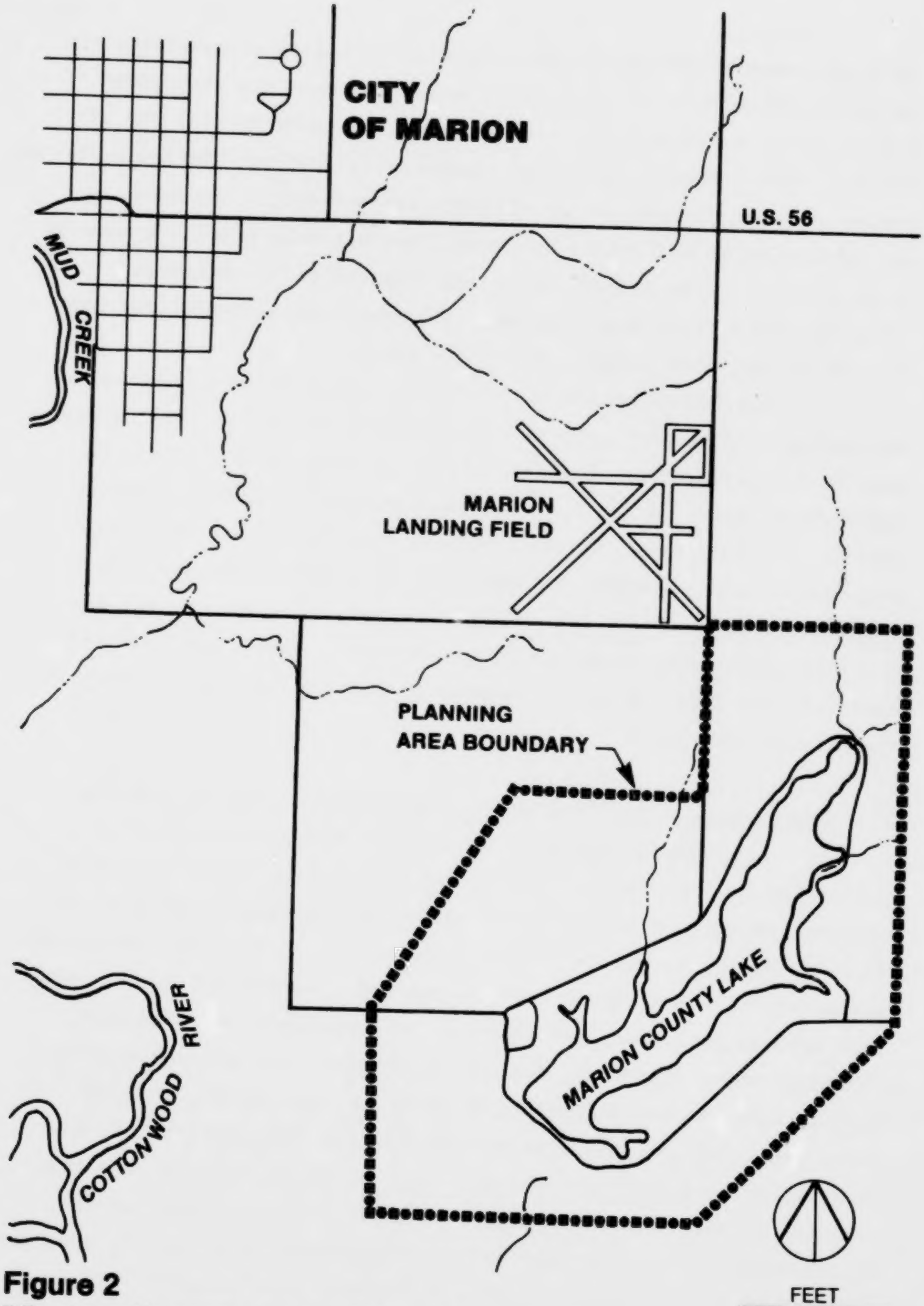


Figure 2
Marion County Lake Planning Area

local governments are not always financially capable of providing the necessary wastewater treatment facilities, Congress has authorized federal grant assistance for such construction under Section 201 of the Act. For conventional sewage treatment facilities, the Act authorizes grants up to 75 percent of the eligible project costs. To encourage new approaches to wastewater treatment, the Act will provide grants up to 85 percent of the project costs for "innovative or alternative" (I/A) wastewater treatment systems. The remaining project costs must be paid by the state and/or local governments.

This federal grant assistance is administered by EPA and is awarded in a three-step process. The first grant to the local government is for preparation of a Facility Plan, which is a preliminary engineering report analyzing treatment needs, alternative treatment methods, existing sewer system adequacy, cost estimates, and also includes an environmental assessment of the project proposed. Upon approval of the Facility Plan, a Step 2 grant is awarded to prepare detailed engineering plans and specifications. When these have been approved, the Step 3 grant is awarded to provide the federal share of the construction costs.

2. Description of Existing Facilities and Water Quality Problems

a. Existing Facilities. The present method of wastewater collection and treatment at the Marion County Lake is by individual on-site systems, including septic tanks, holding tanks, and privies. In 1973, Marion County adopted a sanitary code to regulate the installation of wells and septic tank systems (1). Nearly all of the septic tank systems previously installed at the lake would not have been permitted under this code, but the regulations were not retroactive. Septic tanks are not allowed to be built on lots smaller than one acre, where the soil percolation rate is less than one inch per hour, where there is a well within fifty feet, or where there is less than six feet of soil over impervious rock formations (1). Most of the subdivisions at the lake were originally platted as 50 foot by 100 foot lots, which are too small to contain a house, a well, and a well-designed septic tank and leach field system. The pattern of development at the lake has been irregular because the actual property sizes varied widely, with many owners buying more than a single 50 foot by 100 foot lot.

There are twenty private privies around the Marion County Lake, of which nine are still being used, mainly by weekend visitors (2). There are eighteen holding tanks, eight of which were installed for new houses on lots too small for septic tanks. The others were installed either voluntarily or after an existing septic tank had failed (3). The total number of privately-owned septic tanks at the lake is estimated to be 150.

There are a number of septic tanks, holding tanks, and privies on the County-owned land at the lake (4). These are used by visitors and by the residents of the 56 trailers on leased County land. A 1,500-gallon septic tank behind the lake office serves the meeting hall and the lake manager's house and office. All other County-owned sewage systems at the lake are either holding tanks or vault privies, and are emptied as needed. These systems include two 800-gallon holding tanks near the heated dock, two 300-500 gallon holding tanks near the beach, and six privies dispersed around the lake. The facilities for the trailers on the County-owned land near the dam are located near the hall, and consist of two 1,200-gallon and two 800-gallon holding tanks, and a dumping station. Trailer residents are permitted to discharge wash water into nearby ditches, but it is difficult to ensure that that is all that is being discharged (5). Figure 3 shows the location of the septic tanks, holding tanks, and privies in the study area.

Records of failures of the on-site systems at the Marion County Lake were not kept before the enactment of the sanitary code in 1973, and not all failures are known because the systems are not regularly inspected. A few overt failures have occurred, with the subsequent installation of holding tanks or improved lateral lines.

Many of the holding tanks at the lake serve houses owned by weekend visitors, and need to be emptied only a few times per year.

Holding tanks owned by permanent residents may have to be pumped more frequently. The septic tanks at the lake are emptied when needed, as determined by the individual owners. The privately-owned privies are rarely emptied. Septage is removed from septic tanks, holding tanks, and privies by several local septic tank service companies, who discharge the wastes into the City of Marion's sewage treatment lagoons (6). Some of the pumped septage, however, is reportedly discharged on local fields, without the knowledge or authorization of the County Health Department (3).

b. Soil Constraints. Soils in the Marion County Lake area are mostly silty clays developed by weathering and erosion of the underlying limestone and shale deposits. Soil cover is generally thin (less than five feet), especially over the limestones. The limitations of various soils for use as septic tank leach fields are rated by the Soil Conservation Service as slight, moderate, or severe. All of the soils in the Marion County Lake area except those immediately below the dam have severe limitations for leach fields, as shown on Figure 4. More detailed information on soils in the study area can be found in Appendix B.

The Facility Plan submitted by the Marion County Lake Improvement District (LID) indicates that the present individual treatment systems in the study area do not adequately protect the community's health and environment from sewage contamination. Although it gives no documentation of extensive septic tank failures, the Facility Plan concludes that, based on the poor soil conditions, shallow soil depths, and small lot sizes, the septic tanks should be replaced. It further determines that there is a potential public health hazard from the septic tanks in the form of bacterial and chemical contamination of individual drinking water wells, and of the lake, which is used for swimming. The County Sanitarian concurs with the Facility Plan recommendations, based on the reported septic tank failures and contaminated wells, and on the soil and site conditions described above (7).

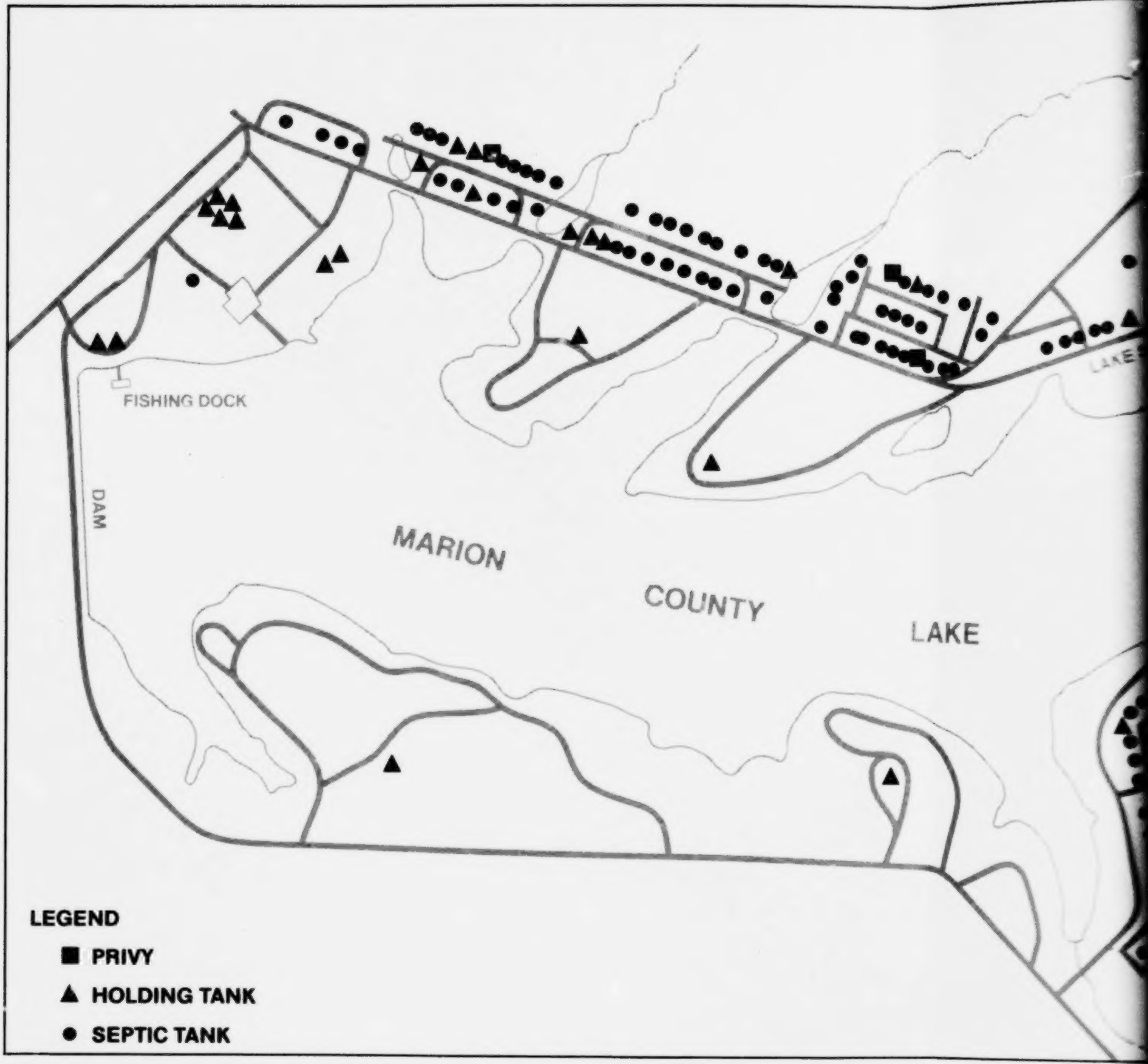
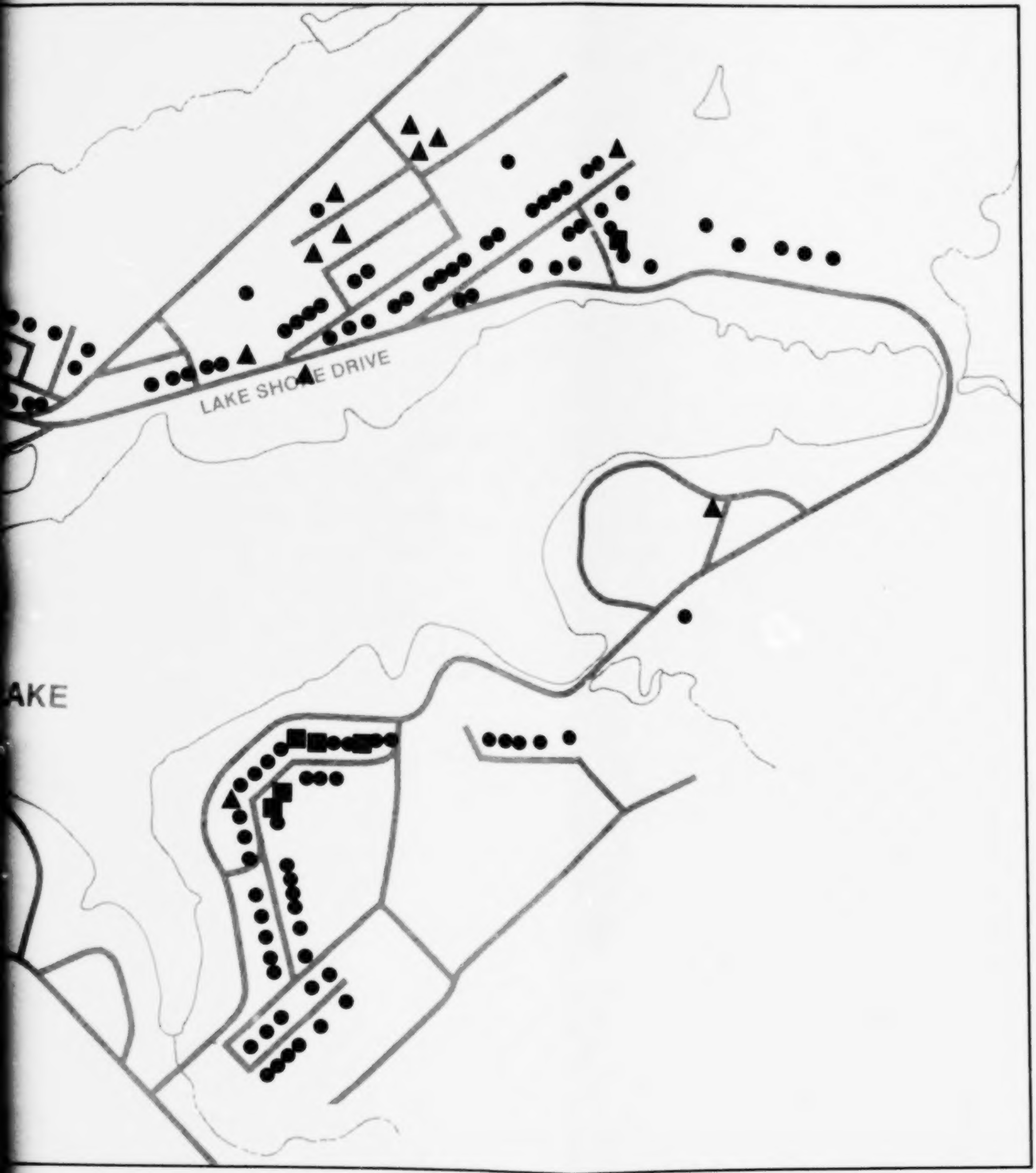
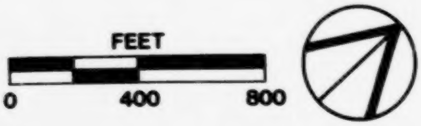


Figure 3

Existing Wastewater Treatment Facilities





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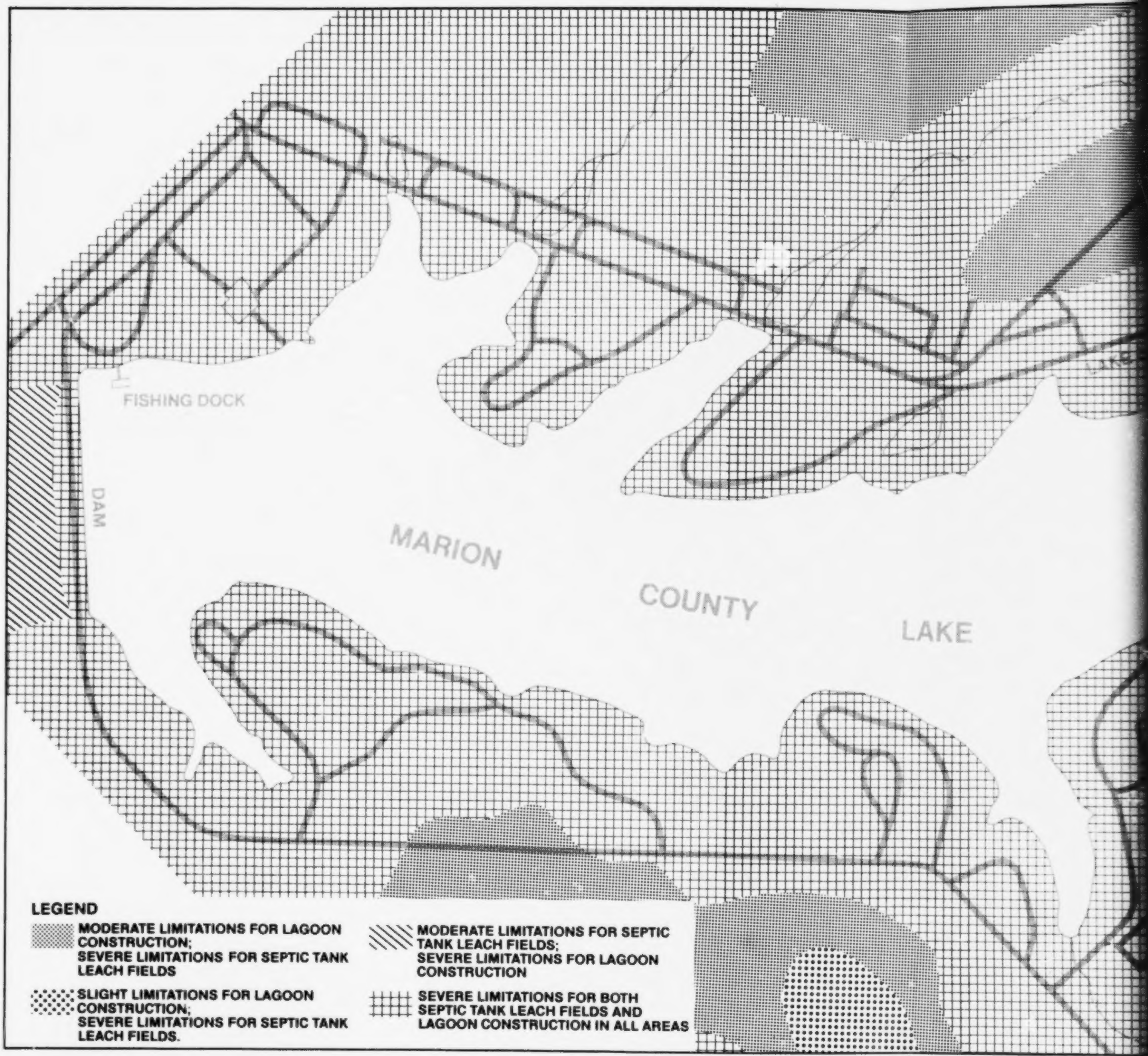
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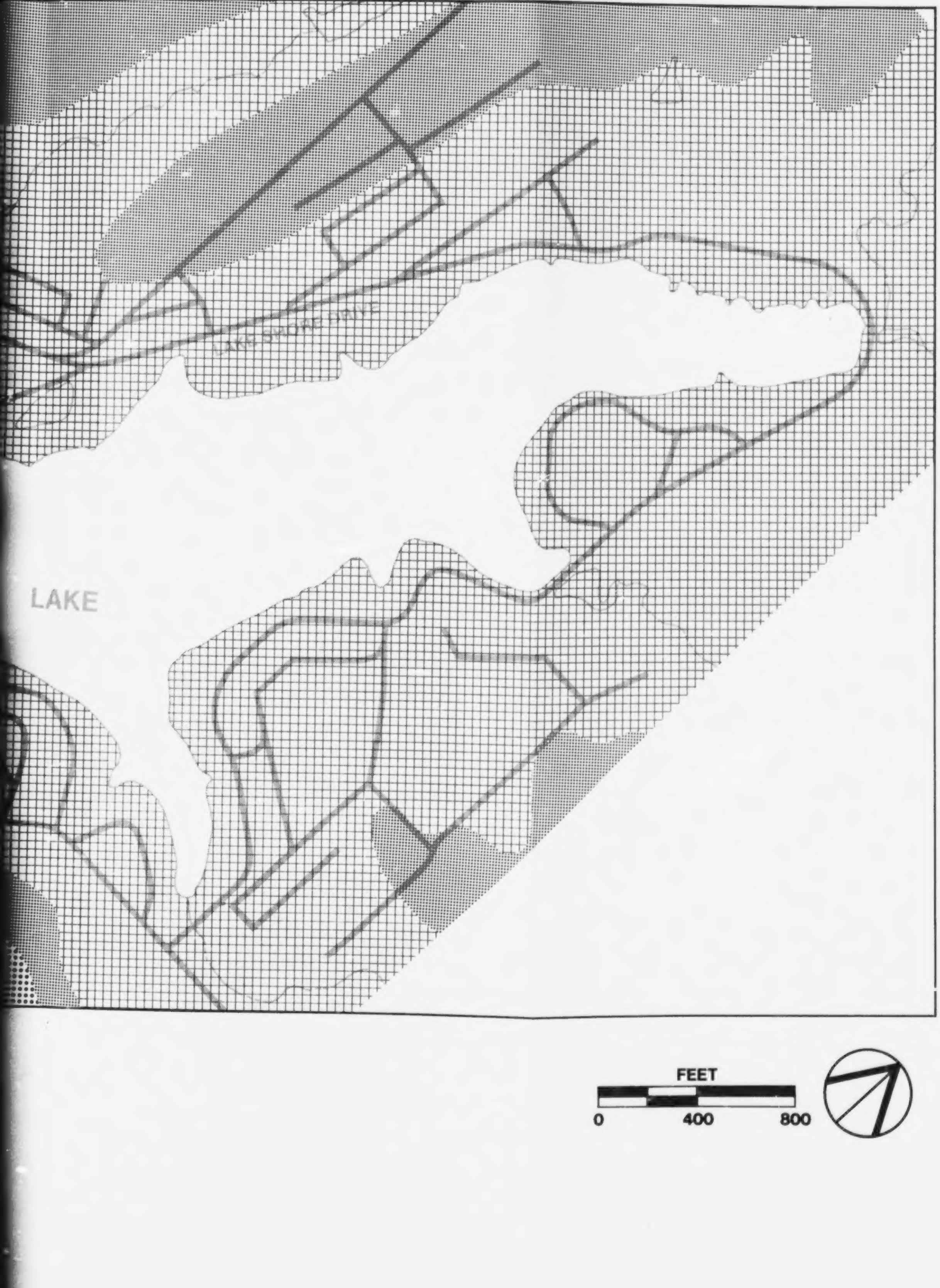
MODERATE LIMITATIONS FOR LAGOON CONSTRUCTION; SEVERE LIMITATIONS FOR SEPTIC TANK LEACH FIELDS
SLIGHT LIMITATIONS FOR LAGOON CONSTRUCTION; SEVERE LIMITATIONS FOR SEPTIC TANK LEACH FIELDS.
MODERATE LIMITATIONS FOR SEPTIC TANK LEACH FIELDS; SEVERE LIMITATIONS FOR LAGOON CONSTRUCTION
SEVERE LIMITATIONS FOR BOTH SEPTIC TANK LEACH FIELDS AND LAGOON CONSTRUCTION IN ALL AREAS

Figure 4

Soil Limitations for Sewage Treatment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3. History of the Grant Application

In view of this water quality situation, the Marion County Lake Improvement District determined to seek federal assistance to plan and construct sewerage facilities. The District applied for Step I planning funds on October 4, 1977. After review by the State of Kansas and the Flint Hills Regional Council, the A-95 review agency for the county, EPA awarded a Step I grant on May 8, 1978 for the development of a Facility Plan. The District then contracted with Reiss & Goodness Engineers of Wichita, KS, to prepare the Facility Plan, which was submitted to EPA on March 22, 1979, and is presently being reviewed by EPA and the Kansas Department of Health and Environment.

4. Facility Plan Alternatives

a. Treatment Alternatives. The Facility Plan considers 6 treatment system alternatives, which are compared on the basis of cost effectiveness and ability to abate existing and future water pollution and public health problems.

1) Lagoon with Zero Discharge. This alternative consists of a two-cell lagoon designed to dispose of the total wastewater flow by evaporation and percolation. It is rejected in the Facility Plan because the large amount of land required (approximately 25 acres) makes it uneconomical.

2) Aerated Lagoon with Continuous Discharge. This alternative consists of a three-cell lagoon, with an aerated cell accomplishing 70 percent of the five-day Biochemical Oxygen Demand (BOD_5) removal, and unaerated second and third cells removing the remaining BOD_5 necessary to meet effluent requirements. A total of three acres would be required for the lagoon. This alternative is rejected because of its high equipment, operation, and maintenance costs.

3) Lagoon with Land Application by Spray Irrigation. This alternative has a three-cell waste stabilization pond to provide the required 90-day storage and primary treatment, and spray irrigation of the effluent. This alternative is rejected because of the equipment

costs and large land requirements. The pond would require 16 acres, and 28 acres would be needed for irrigation.

4) Lagoon with Controlled Discharge. This alternative uses a four-cell lagoon with a total detention time of 120 days, so that discharges may be limited to periods of high flow in the receiving stream. The lagoons are not aerated, and must be shallow enough to avoid becoming anaerobic, which requires a large surface area. This alternative is rejected because of high land (approximately 11 acres required) and operation costs.

5) Lagoon with Continuous Discharge. A four-cell lagoon is proposed for this alternative. Although operation costs are less than for either the aerated lagoon or land application alternatives, land requirements are high enough (7 acres) to make this alternative uneconomical.

6) Regional Plant Concept. This alternative is selected by the Facility Plan as being the most desirable. It entails pumping Marion Lake's wastewater to the City of Marion's proposed new treatment plant. This plant will be a 0.5 MGD oxidation ditch, southeast of the city. The facility will discharge treated effluent into a tributary of the Cottonwood River. The effluent limitations for this facility will be 30 mg/l BOD_5 and 30 mg/l TSS, because the receiving stream is designated a Class B water (8).

b. Collection Alternatives

Five collection system alternatives are considered in the Facility Plan.

1) Vacuum Sewer System. This alternative is dependent upon maintaining a vacuum in all the collection lines. The vacuum sewer system alternative designed for the Marion County Lake area uses two central vacuum stations. The wastewater from several homes is collected by a short section of gravity sewer and discharged to a 30-gallon holding tank, from which it travels to a central vacuum station. The operation and maintenance of vacuum sewers are costly and difficult, and the system's reliability is suspect. For these reasons, this alternative is rejected.

2) Pressure Sewer System. Pressure sewers utilize sealed, small-diameter pipelines with a number of pressurizing inlet points, each serving one or more houses, and which join to a single outlet. The pressurized sewer system designed for the Marion County Lake uses grinder pumps at each home and business. Sewage flows to the grinder pumps, where it is reduced to a slurry and pumped to the treatment facility. The high cost of installing, operating, and maintaining individual grinder pumps precludes the selection of pressure sewers.

3) Holding Tanks. This alternative consists of installing reinforced concrete underground holding tanks at each home, to store all wastewater. A tank truck or, "honeywagon," purchased by the community would empty the holding tanks as needed, and haul the sewage to a nearby wastewater treatment facility, most likely the City of Marion's, for disposal. This alternative was rejected because of high operation and maintenance costs.

4) Septic Tanks and Lateral Lines with Improved Maintenance. In this alternative, a public body would be set up to supervise the installation and operation of all on-site systems at the Marion County Lake. There are a number of legal difficulties that would need to be resolved before such a system could be established. The Facility Plan states that septic tanks cannot succeed at the Marion County Lake because the soil is too impermeable, soil cover is too shallow, and most of the lots are too small for adequate leach fields, and thus rejects this option.

5) Conventional Gravity Sewer System. The wastewater collection system selected in the Facility Plan as being the most cost-effective is the conventional gravity sewer system. In this alternative, wastewater would flow in eight-inch diameter sewer mains by gravity to a pumping station, where the wastewater would be pumped to the new Marion treatment plant. The costs of constructing a gravity sewer system at the Marion County Lake would be minimized by installing the lines only deep enough to serve the first floors of homes, and not to specifically serve any basements.

5. Facility Plan Proposed Project

The project determined to be the most cost-effective and environmentally sound by the Facility Plan is the regional plant concept, i.e., for the wastewater generated at the Marion County Lake to be collected by a gravity sewer system, and pumped to, and treated in, the City of Marion's proposed wastewater treatment facility.

The proposed gravity sewer system is designed for a 1995 projected population of 1,400 permanent residents. All development at the lake would be served by the proposed system. The collection system would encircle the lake, and consist of approximately 12,800 linear feet of eight-inch sewer pipe and 12,800 linear feet of small-diameter force main. An additional 10,100 linear feet of 6-inch PVC force main would convey the wastewater from the lake to the City of Marion's new treatment facility. Figure 5 shows the proposed system.

C. PURPOSES AND ISSUES OF THIS EIS

1. Legislative Background

The National Environmental Policy Act of 1969 (NEPA), Public Law 91-190, requires that all agencies of the Federal Government incorporate into their decision-making process careful consideration of the environmental effects of all proposed actions. In instances where these proposed actions could significantly affect the quality of the human environment, Section 102(2)(c) of NEPA requires that the agency prepare an environmental impact statement.

EPA performed an environmental review of the proposed project and determined that it could have significant effects on the environment in the Marion County Lake area. Therefore, on August 14, 1978, EPA issued a Notice of Intent to prepare an EIS. This EIS fulfills the requirements of NEPA, and has been prepared in accordance with the Council on Environmental Quality's Regulations dated November 29, 1978, and the subsequent EPA implementation regulations of June 18, 1979.

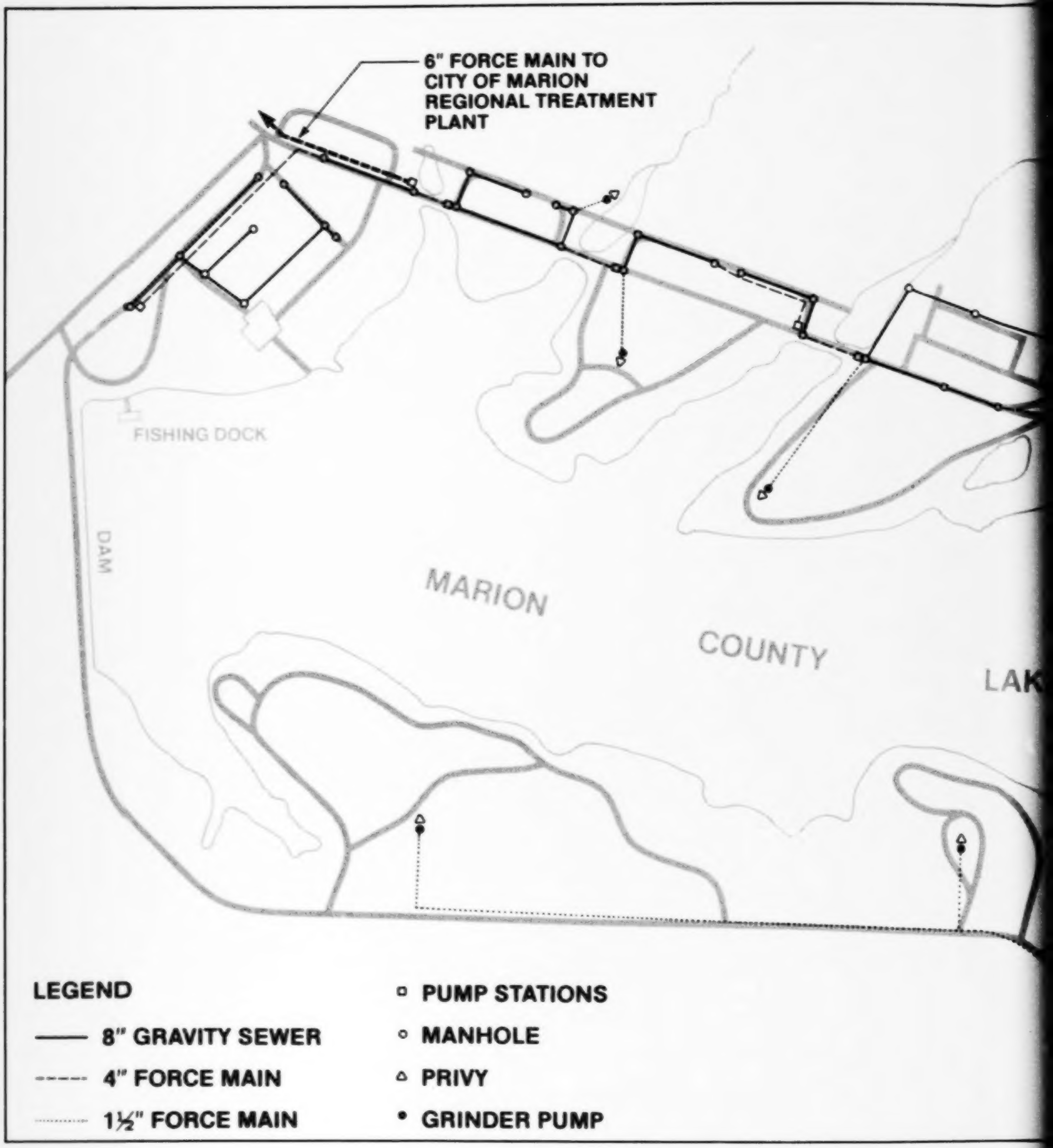
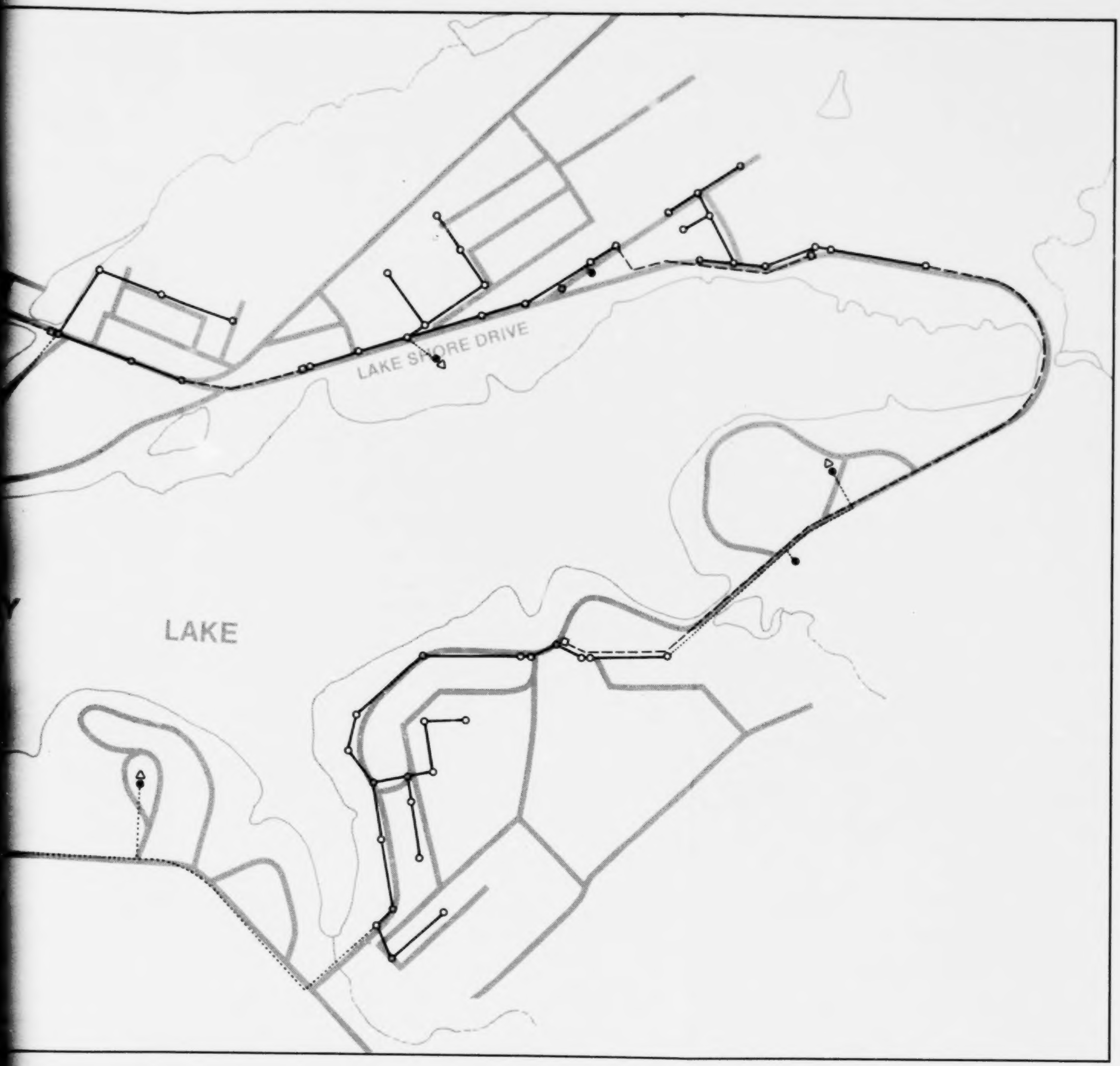


Figure 5

Facility Plan Proposed Project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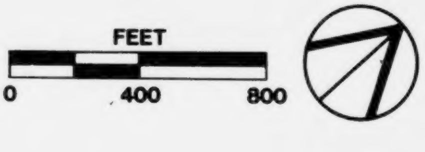
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2. Major Issues

The Notice of Intent identified several significant environmental issues associated with the proposed project. These issues, and others identified during the preparation of this EIS, are outlined briefly in the following sections.

a. Potential Secondary Development. The proposed project could encourage further residential development around the lake, and also along the force main corridor from the lake community collection area to the City of Marion treatment plant. The potential impacts of this growth on the lake as a recreational resource and on the native grassland habitats of the area were identified as major concerns, and are addressed in this EIS.

b. Water Quality and Public Health. The threats to lake water quality and public health posed by failing septic systems are the problems that prompted the initiation of the Marion County Lake sewerage project. The extent and severity of those problems are addressed in this EIS. The potential for additional adverse impacts on the water quality of the Cottonwood River, the stream proposed to receive the treated effluent, is also assessed, as is the possiblity of destruction of habitat of the Neosho Madtom (*Noturus placidus*), a fish classified as an endangered species by the State of Kansas.

c. Archaeological Sites. Construction of the collection lines and force main could disrupt archaeological sites in the area, as could other development induced by the project. A cultural resources survey has been conducted as a part of this EIS to assess these possibilities.

d. Economic Impacts. The local share of the project construction costs and all of the system operation and maintenance costs must be borne by the residents of the service area, many of whom are retired on fixed incomes. Concern about the possible effects of this financial burden on the local residents prompted an examination of the cost effectiveness of the alternatives considered and the sizing of the proposed project. Estimates of present population and future projections have been evaluated as part of this effort.

II DEVELOPMENT OF ALTERNATIVES

A. INTRODUCTION

This chapter presents the rationale used in developing several additional project alternatives to be examined along with the Facility Plan proposed project. These new alternatives were developed to more directly address the major issues and to reflect the more detailed information made available by field investigations conducted for this EIS. In particular, this information concerned the extent of existing water quality problems and the estimates of present and future population used as a basis for system design.

During the preparation of the EIS, extensive tests were conducted to better define the water quality problems in the Marion County Lake area. These tests included water quality sampling in the lake and at many individual wells, infrared aerial photography to determine leach field failures, and septic leachate sampling in the lake. Results of these tests indicated that water quality problems were not as extensive as originally believed and that some smaller, more site-specific alternatives might provide adequate treatment and should be investigated in more detail.

Considerable data on present and projected population levels was also obtained. Sources of this information included County Assessor's records, electric service billings, park camping fee records, and field interviews with local officials. Analysis of this data indicated that revisions of the design population projections should be made, resulting in reduced project design sewage flows. These revisions prompted a re-analysis of several alternatives considered in the Facility Plan. The design parameters used in developing these alternatives are presented in the following section.

B. DESIGN PARAMETERS

1. Population Projections

The large seasonal variations in the number of people residing in the Marion County Lake planning area make estimating the current and future populations more complex than is typically the case for a small rural community. Data gathered during the preparation of this EIS from a variety of local sources indicate that the lake population can be classified into several groups having relatively similar patterns of residence. Projections are developed for each of these groups and then added to obtain projections of the peak and average populations at the lake. A description of the methodology used in calculating these projections is presented in Appendix A.

a. Current Population Estimate. At present, the population consists of four major groups - permanent residents, seasonal residents, campers, and residents of the trailer park. The majority of the permanent residents are retirees, whereas more of the seasonal residents are families with children. Most of the groups camping at the lake and using the trailer park are also families with children.

The current average and peak day populations are listed in Tables 1 and 2. These estimates indicate that, over the course of an entire year, the population averages approximately 373 persons per day. On the busiest day of the year, such as the Fourth of July or Memorial Day, there are approximately 1600 people at the lake. These figures reflect the number of people who actually reside or camp at the lake overnight, and not those who come only for the day.

b. Population Projections. These projections assume that the growth trends established in the last decade will continue through the year 2000. The number of seasonal units will continue to decrease and the number of permanent units to increase as more people convert their seasonal homes to retirement homes. A summary of the projections of the permanent and seasonal populations is listed in Table 3. Projections of the number of campers are based on the expected population increases in the Wichita SMSA.

TABLE 1

CURRENT POPULATION ESTIMATE

AVERAGE DAY

Group	Units	Persons per Unit	Population	Days/Yr.	Person-Days/Yr
Holiday Campers	300	3.50	1050	12	12,600
Weekend Campers	100	3.50	350	46	16,100
Seasonal-Summer	59	3.06	181	240	43,440
Seasonal-Weekend	40	3.06	122	48	5,856
Permanent Residents	67	2.13	143	365	52,195
Seasonal Trailers:					
(Summer Wkd.)	20	3.50	70	46	3,220
(Holiday Wkd.)	30	3.50	105	12	1,260
(Winter Wkd.)	10	2.50	25	52	1,300
Total Person-days/Yr.					135,971

Average Persons per Day 373

TABLE 2

CURRENT POPULATION ESTIMATE

PEAK DAY

Group	Units	Person per Unit	Population
Holiday Campers	300	3.50	1,050
Seasonal Residents	99	3.06	303
Permanent Residents	67	2.13	143
Seasonal Trailers	35	3.50	123
Peak Day Population			1,619

TABLE 3

PROJECTED PERMANENT AND SEASONAL POPULATION

	Permanent		Seasonal	
Year	Units	Population	Units	Population
1985	84	194	92	282
1990	100	230	84	257
1995	116	267	77	236
2000	132	303	69	211

Average day and peak day projections for the year 2000 are listed in Tables 4 and 5.

2. Design Flows

Based upon these new population projections, revised wastewater flows for the design year of 2000 were developed. These new design flows were used to size all of the new alternatives considered in this EIS in order to provide an equitable basis for comparison. Flow rates for each of the population categories are based upon EPA guidelines and discussions with the Facility Plan consultants. Tables 6 and 7 present the average day and peak day design wastewater flows and BOD loadings. The revised average day design flow shown in Table 6 is approximately 27 percent of the design flow originally used in the Facility Plan.

3. Effluent Limitations

The Marion County Lake Improvement District has three options for surface disposal of its treated wastewater. These include discharge into the Cottonwood River or one of its tributaries, into the County Lake, or by land application. Effluent limitations of the State of Kansas govern the degree of treatment that must be achieved for all such discharges.

All free-flowing streams in the Neosho River basin, including the Cottonwood River and its tributaries, are designated Class B waters. Lakes and reservoirs in the Neosho River basin are designated Class A waters. Class A waters are protected for body contact recreation;

TABLE 4
POPULATION PROJECTION
AVERAGE DAY POPULATION
YEAR 2000

Group	Units	Persons Per Unit	Population	Days/Yr.	Person-Days/Yr.
Holiday Campers	405	3.50	1,418	12	17,016
Weekend Campers	135	3.50	473	46	21,758
Seasonal-Summer	41	3.06	125	240	30,000
Seasonal-Weekend	28	3.06	86	48	4,128
Permanent Residents	132	2.29	302	365	110,230
Seasonal Trailers:					
(Summer Wkd.)	25	3.50	88	46	4,048
(Holiday Wkd.)	38	3.50	133	12	1,596
(Winter Wkd.)	13	2.50	33	52	1,716
Total Person-days per Year					190,492
Average Persons per Day		522			

TABLE 5
POPULATION PROJECTION
PEAK DAY
YEAR 2000

Group	Units	Person per Unit	Population
Holiday Campers	405	3.50	1418
Seasonal Residents	69	3.06	211
Permanent Residents	132	2.29	302
Seasonal Trailers	44	3.50	154
Peak Day Population			2085

TABLE 6

AVERAGE DAY DESIGN FLOW

YEAR 2000

Population Category	Population	Days/Yr	Flow (gpcd)	BOD (lb/cap/day)	Total Flow (gpy)	Total BOD (lb/yr)
Permanent	302	365	65	0.17	7,165,000	18,700
Seasonal -						
Summer	125	240	50	0.17	1,500,000	5,100
Weekend	86	48	50	0.17	206,400	700
Trailers -						
Weekend	88	46	50	0.17	202,400	700
Holiday	133	12	50	0.17	79,800	300
Winter	33	52	50	0.17	85,800	300
Campers -						
Weekend	473	46	25	0.17	544,000	3,700
Holiday	1418	12	25	0.17	425,400	2,900
YEARLY TOTAL					10,208,800	32,400
DAILY AVERAGE					28,000 gpd	90 lb/day

TABLE 7
PEAK DAY DESIGN FLOW
YEAR 2000

Population Category	Population	Flow (gpcd)	BOD (lb/cap/day)	Total Flow (gpd)	Total BOD (lb/day)
Permanent	302	65	0.17	19,630	50
Seasonal	211	50	0.17	10,550	40
Trailers	154	25	0.17	3,850	30
Campers	1,418	25	0.17	35,450	240
PEAK DAY TOTAL	2,085			69,500	360

propagation of warm freshwater aquatic and semi-aquatic biota, water fowl, and wildlife; public and industrial water supplies; and agricultural purposes. Class B waters are protected for the same uses as Class A waters, except that body contact recreation is downgraded to secondary contact recreation (9). Municipal wastewaters discharged to Class B waters, such as the Cottonwood River or its tributaries, must meet secondary treatment effluent standards of 30 mg/l BOD_5 and 30 mg/l TSS. Municipal discharges to Class A waters must be disinfected in addition to meeting those standards. This standard would apply for discharges to the Marion County Lake (8).

If the LID decided to dispose of its wastewater by land application a minimum of primary treatment would be required (19). Wastewater land application systems are classified in Kansas as either treatment oriented, with no direct point discharge to State waters, or irrigation oriented, with periodic point discharges to State waters. Any irrigation-oriented land treatment system must include secondary treatment before discharge. Disinfection is required for any land treatment system that discharges on land areas such as parks, athletic fields, or golf courses, where there is a probability of body contact. Subsurface treatment of wastewaters in septic tank leach fields is not governed by State regulations, although their design and construction is regulated by the Marion County Sanitary Code.

C. SYSTEM COMPONENTS

In developing or revising wastewater collection and treatment alternatives for the Marion County Lake planning area, consideration was given to the full range of technologies available for each part of the system. Separate alternatives were investigated for wastewater collection, wastewater treatment, effluent disposal, and sludge treatment and disposal. Discussions of the various technologies considered are presented in the following sections.

1. Collection Systems

In small or sparsely-populated communities, the cost of collecting wastewater for central treatment is frequently a major portion of the total cost of the treatment system. The choice of collection system for a centralized wastewater treatment system thus becomes an important part of the overall investigation.

a. Gravity Sewers. These are used in most wastewater collection systems because of their low operation and maintenance costs. In sparsely-populated, rocky, or hilly areas, however, gravity sewers are frequently not cost-effective.

b. Pressure Sewers. Pressure sewers use sealed, small-diameter pipelines buried just below the frost penetration depth. The system consists of a number of pressurizing inlet points, each of which serves one or more houses, and which join to a single outlet. The two major types of pressure sewer systems are the grinder pump (GP) system, in which grinder pumps are installed at each inlet point, and the septic tank effluent pumping (STEP) system, which utilizes the individual septic tanks for collection and primary treatment.

c. Vacuum Sewers. This alternative is dependent upon the maintenance of a vacuum in the collection lines. There is less uncertainty about the performance of the individual lines than for pressure sewers, because a central source controls the vacuum throughout the system. Water conservation is increased by the use of vacuum toilets. Vacuum sewers are more easily installed than are gravity sewers because of their smaller size and the shallower depths required. However, it is frequently difficult to maintain a vacuum as the lines age and deteriorate.

d. Holding Tanks. These are reinforced concrete, steel, or fiberglass tanks (1000-1500 gallons) installed in place of septic tanks. They collect and contain household wastes, but do not discharge an effluent, and thus must be periodically emptied. The septage removed is hauled to a nearby treatment plant by a large tank truck, or "honeywagon."

2. Wastewater Treatment

a. Centralized Treatment. In centralized treatment schemes, wastewater is collected and treated at one site. A number of treatment methods are available to communities with small wastewater flows. The method chosen depends upon the volume and characteristics of the wastewater, the construction and operating costs, the environmental consequences, and the ability to produce an effluent that meets state requirements. The site of any centralized wastewater treatment facility for the Marion County Lake depends primarily upon the effluent limitations at the expected discharge point and the availability of suitable land.

1) Wastewater Stabilization Ponds. These are defined as "shallow man-made basins utilizing natural processes under partially controlled conditions for the reduction of organic matter and the destruction of pathogenic organisms in wastewaters" (10). Stabilization ponds, or lagoons, are often used for secondary treatment in rural communities because of their low construction and operating costs (11). Lagoons can be classified as aerated, aerobic, or anaerobic. The type of lagoon used is selected based on such factors as the volume and characteristics of the wastewaters and the degree of treatment required.

a) Aerated Lagoons. Kansas regulations define two types of aerated lagoons, facultative and complete-mix. In facultative aerated ponds, some solids are deposited due to incomplete mixing. Anaerobic decomposition then occurs at the bottom of the lagoon, and the by-products subsequently decompose aerobically in the upper layers of the sludge blanket. Facultative ponds are between 5 and 12 feet deep. In complete-mix aerated lagoons, typically 10-12 feet deep, sufficient aeration is provided to maintain the suspension of all solids and uniform oxygen dispersion, resulting in completely aerobic decomposition of all solids (5, 10).

b) Aerobic Lagoons. This type of lagoon is oxygenated solely by algal photosynthesis and wind action across the surface of a relatively shallow pond. Kansas regulations distinguish three types of aerated lagoons: non-overflowing or evaporative ponds; discharging ponds; and controlled discharge ponds. A non-overflowing pond depends upon evaporation and water loss through the pond sides and bottom to dispose of the wastewater. A controlled discharge pond treats and stores wastewater for discharge during times when the receiving stream is best able to assimilate the effluent. Discharging ponds continuously release treated effluent to a receiving stream. Aerobic lagoon systems typically consist of two or more suitably-sized ponds, each of which is up to 5 feet deep, except for the final pond, which may be deeper (10).

c) Anaerobic Lagoons. This type of waste stabilization pond is normally used for the treatment of highly-organic industrial wastes, such as from meat packing plants. Kansas regulations do not permit anaerobic lagoons to be used as municipal treatment facilities (10) because adequate treatment usually requires a surface layer of grease, which is not provided by most municipal wastewaters (12).

2) Trickling Filters. This aerobic, attached-growth biological treatment method consists of a bed of highly permeable media (usually rocks) on which microorganisms become attached, and through which wastewater is percolated or trickled. Trickling filters are the most common of the attached-growth treatment methods. They are particularly advantageous for small communities because of their ease of operation, low cost, and ability to accept shock loads. Trickling filters are classified, based on hydraulic and biological loading, as either high rate, which are used prior to further biological treatment, or standard rate. New trickling filter systems are usually preceded by primary settling and followed by clarification. Single-stage rock-media trickling filters, by themselves, are not allowed for new wastewater treatment facilities because they cannot meet the secondary treatment effluent limitations of 30 mg/l BOD_5 and 30 mg/l TSS without additional treatment (13).

3) Activated Sludge Plants. This treatment process consists of suspending aerobic micro-organisms in wastewater that is then aerated and mixed. The activated sludge process is influenced by many factors, which makes it among the most difficult and expensive treatment

processes to operate properly (13). It is intended primarily for treatment of large waste flows, but has been modified for small communities. Many of these modifications are commercially available as "package plants," which are pre-engineered and easily assembled from standard components.

An oxidation ditch is a modification of the activated sludge process that is particularly suitable for small communities. An oxidation ditch consists of a continuous channel through which the wastewater is circulated, while being agitated by surface aerators. Most facilities using this process omit primary sedimentation, but include clarification following the oxidation ditch.

b. Decentralized Treatment. Wastewater is treated as close to the individual sources as feasible in decentralized treatment. The most common method is the septic tank and soil absorption system, but a number of other systems have been developed. A community decentralized treatment system consists of any combination of the many types of on-site systems, which may be clustered or individual. These individual or clustered systems may be managed in several ways.

1) Engineering Alternatives

a) Conventional Septic Tank - Soil Absorption System. The conventional septic tank is a large (750-1000 gallon) underground tank into which wastewater is discharged. Dense solids settle to the bottom of the tank, and grease and oil float to the top. The settled solids decompose anaerobically to some extent, and are periodically removed. The septic tank effluent flows into the soil absorption system, also called a lateral field, or a leach field. Further decomposition takes place as effluent percolates through the soil. Failures of conventional systems are more often caused by poor installation and maintenance than by the complete unsuitability of septic tanks for the area. Modifications can be made in some cases to improve the performance of on-site systems in areas where conventional septic tanks have not been successful.

b) Mound Systems. In areas that have shallow bedrock, or high groundwater, or permeability rates that are either too high or too low, the soil absorption system may be modified to a mound system. This is accomplished by building the lateral field in a mound of medium sand and topsoil on top of the existing ground. This allows the septic tank effluent to be spread over a large area above the indigenous soils and groundwater.

c) Dual Field Systems. Designing a septic tank - soil absorption system to include two leach fields allows one field to "rest" while the other is receiving the septic tank effluent. Resting an absorption field for 6 to 12 months allows the ground to drain and air to reenter the spaces between soil particles, which removes clogging materials by physical and biochemical means. An alternating valve directs flow from the septic tank to one of the dual fields. If suitable land is available, newly installed or upgraded septic tank systems will be better able to handle waste flows if they include dual absorption fields.

d) Dosing Systems. These systems were developed to increase the life of the absorption field and decrease the land requirements. Studies have shown that periodic, rather than continuous, dosing increases leach field life by preventing anaerobic conditions from occurring. A pump or siphon installed between the septic tank and leach field doses the field 1 to 4 times daily, ensuring uniform distribution of the effluent and reducing soil clogging. Dosing systems are particularly advantageous for leach fields in coarse-grained soils, where uniform distribution of the septic tank effluent may be difficult (14).

e) Aerobic Systems. Wastewater treated under aerobic, rather than anaerobic, conditions produces a much more biologically stabilized effluent. An aerated, or aerobic, unit is an underground system with an initial settling chamber (as in a conventional septic tank), an aerated chamber, and a final settling chamber. Aerated systems produce an effluent that may be discharged to surface waters if disinfection, and possibly some additional treatment, are added. The disadvantages of these systems for small communities include high initial costs, the higher costs of the energy-intensive operation, and the more elaborate regular maintenance required.

f) Sand Filtration. Several types of filters, in conjunction with other systems, may produce effluent of high enough quality to be discharged to surface waters. The three types of sand filters used in the treatment of small wastewater flows are intermittent sand filters, subsurface (or buried) sand filters, and recirculating sand filters. Intermittent sand filters have pretreated wastewater (from a septic tank) spread over a 2-3 ft deep bed of sand. The effluent is collected for further treatment before discharge. Buried sand filters are constructed below the ground, and are periodically flooded with pretreated wastewater (septic tank effluent) at approximately 1 gal/day/ft^2. The effluent is collected for further treatment (15,16). Recirculating sand filters consist of a recirculation tank and a coarse sand filter. The septic tank effluent is pumped through the filter, collected, and returned to the tank. Wastewater is recycled through the filter at a recommended ratio of 4:1 (recycle:forward flow). Filtered effluent is discharged when the tank becomes full.

g) Evapotranspiration Systems. These systems are recommended for those areas where poor soil conditions prevent the use of soil absorption systems, and where annual evaporation substantially exceeds annual precipitation. The wastewater is eliminated by evaporation and plant transpiration. The system consists of a bed of sand, from 1-1/2 to 3 feet thick, connected to a septic tank. Many evapotranspiration systems overflow seasonally because of poor design or construction, particularly of the liner. The only operation and maintenance required is that associated with the septic tank.

2) Management Alternatives. The ability of anv decentralized wastewater treatment system to operate properly depends primarily upon how well the individual on-site systems are maintained. There are several options than can be taken by a community setting up a decentralized system management program. The managment method chosen depends upon such factors as the soundness of the present on-site systems and the ability and willingness of the existing political structure to administer such a program.

The basic components of a decentralized system management program are planning, site evaluation, system design, installation supervision, operation, maintenance, financing, water quality monitoring, system inspection, public education, and environmental/public service program coordination (17). Planning involves evaluating the overall suitability of the community for soil absorption systems and deciding which areas in the community may use septic tanks. System design involves specifying the size and type of on-site system to be used, based on a site evaluation performed by qualified personnel. Construction supervision involves inspection of all new systems, and licensing all septic tank installers. Maintenance of the systems is extremely important, but is usually unenforced, and subsequently inadequate. The regulating authority must be empowered to enter private property to inspect systems, and to maintain those that are not operating properly. These duties may be funded by selling permits to each septic tank owner and requiring proof of routine maintenance and inspection before renewal, or by a general user fee levy. Monitoring of surface and groundwater is needed to review the overall success of the program. Finally, the public must understand their part as individual owners in the management program.

3. Effluent Disposal

Marion County Lake's wastewater may be treated at any of several sites. The choice of site depends upon soil and groundwater conditions, the flow and quality of the receiving water, and the ability of the site's ecosystem to accept the discharge.

a. Discharge to the Marion County Lake. The Marion County Lake is relatively low in suspended solids (18) and high in dissolved oxygen compared to neighboring lakes. Most Kansas lakes have enough nutrients (nitrates and phosphates) to support large algal populations, but are limited by high suspended solids concentrations (causing low light penetration) from becoming eutrophic (19). The Marion County Lake has localized algal blooms, especially in the stagnant coves, which is not unusual for old impoundments (20). The sanitary quality of the lake is apparently good, as there have been no recorded violations of the lake's Class A fecal coliform standard (200 organisms/100 ml) (9).

The Marion County Lake is fed by springs and by runoff from pastures used for cattle grazing. The latter is likely the major source of nutrients, bacteria, and organics to the lake.

b. Discharge to the Stream Below the Marion County Lake. There are no available water quality or flow data for the unnamed stream below the Marion County Lake dam. The stream is fed by a number of springs in addition to overflows and seepage from the dam, and does not go dry during the year. Except in stagnant coves and the area just below the dam, the quality of the stream appears to be as good as most spring-fed streams. Runoff accounts for relatively little of the total stream flow (21).

c. Discharge to the Cottonwood River. Limited data characterize the Cottonwood River as similar to the majority of Kansas surface waters, in that it is highly turbid, moderately mineralized, well buffered, well oxygenated, and with low organic loading, and high nutrient and bacterial levels (22). Kansas water quality is highly dependent upon flow, with high flows resulting in the poorest water quality. This is because the impact on water quality from non-point pollutants is substantially greater than that of pollutants from point sources, because of the sparse population in the area and the relatively high number of cattle. High amounts of fecal and total coliform and fecal streptococcus bacteria, suspended solids, and nutrients are evident, particularly during high flows (19). Violations of the river's Class B fecal coliform standard (2,000 organisms/ 100 ml) have been measured in the Cottonwood River downstream of the Marion Reservoir and County Lake (9, 23), and are most likely the result of contributions from non-point sources (including septic tanks) during storms.

The Cottonwood River is west of the study area, and southwest of the City of Marion. Mud Creek and Clear Creek join north of Marion and flow through the city to join the Cottonwood. The South Fork and North Fork of the Cottonwood River join three miles west of Marion.

The North Fork has been dammed by the Corps of Engineers to form the Marion Reservoir. The average flow rate of the Cottonwood River at the USGS sampling point just downstream of the Marion Reservoir over a 9-year period was 87.5 cfs (24).

d. Land Application. In this alternative, treated effluent would be sprayed upon a large tract of land near the lake. The irrigated fields could be used for a golf course, pasture, cropland, athletic fields, or a park. Kansas regulations require treatment before land application. The minimum treatment required depends upon the intended use of the irrigated land (See Section XIII of reference 10).

e. Total Retention. This alternative relies primarily upon evaporation in addition to transpiration by plants to dispose of the wastewater. For a total retention system where soils are highly permeable, the lagoons must be lined to prevent pollution of the groundwater.

4. Septage Handling

The wastes pumped from septic tanks are termed septage, and can be very difficult to treat. Septage is anaerobic, highly variable, odorous, high in organics and solids, and can severely disrupt a small wastewater treatment plant. Communities using septic tanks for treatment must plan for the treatment of septage, which usually must be aerated or otherwise pretreated before final disposal.

The relatively small volume of septage from the Marion County Lake community is discharged directly into the Marion lagoons without pretreatment. If the volume of septage increases appreciably, it may become necessary to discharge the LID's septage into a holding tank or equalization basin at the new Marion oxidation ditch treatment plant to avoid shock loading that would disrupt the treatment process.

D. CRITERIA FOR EVALUATION

To develop revised project alternatives that more directly address the concerns of this EIS, the various system components presented in the previous section were evaluated with respect to the particular conditions in the Marion County Lake planning area. The purpose of this evaluation was to screen out those alternatives which clearly offered fewer advantages than the Facility Plan proposed project. Those alternatives which had the potential to satisfy the evaluation criteria were selected for further detailed analysis in this EIS. The principal criteria used in assessing the potential of the various system components are presented in the following sections.

1. Technical Feasibility

This criterion is an evaluation of the applicability of a particular component to the situation at Marion County Lake and of its ability to solve the area's water quality problems. This criterion became a significant factor in considering septic tank soil absorption field systems. With the exception of the soils immediately below the dam, all of the soils in the entire planning area are rated as having severe limitations for use as septic tank leach fields. (See Figure 5). This rating was due primarily to the very low permeability of the soils and the shallow depth to bedrock. Because of these soil conditions, conventional soil absorption systems were judged to be infeasible, and therefore were not considered in the detailed analysis of alternatives presented in this EIS.

2. Cost Effectiveness

As mandated in the federal regulations governing municipal sewage facility grants, cost-effectiveness must be a major criterion in selection of the proposed project. With limited exceptions for innovative treatment systems, or where there is an overriding environmental concern, EPA must fund the most cost-effective alternative.

Initial screening of the collection and treatment system components eliminated a number of alternatives from detailed analysis. The Facility Plan evaluations of small-diameter pressure and vacuum collection systems were reviewed under the new design parameters, but remained less cost-effective than the proposed gravity collection system. They were therefore not considered as components for the alternatives analyzed in detail. Likewise, aerated lagoons were not analyzed in detail in this EIS because preliminary calculations showed them to still be less cost-effective than other treatment methods considered.

3. Environmental Impact

The consideration of the environmental impact of the various system components also played a role in the selection of the alternatives examined in this EIS. Discharge of treated effluent into the Marion County Lake was eliminated from consideration because of environmental concerns. Although the Kansas Department of Health and Environment regulations would permit discharge to the lake with secondary treatment and disinfection, the addition of such effluent would degrade the existing lake water quality and eventually lead to overenrichment.

III ALTERNATIVES

This chapter presents the specific project alternatives examined in this EIS. These alternatives are based upon the design parameters developed in the previous chapter, and seek to more adequately address the major issues identified in Chapter I. In addition to the No-Action alternative and the Facility Plan Proposed Project, two alternatives are presented which were considered in the Facility Plan, but which are re-evaluated in light of the revised design population projections. Also considered is a more limited alternative that deals only with the particular water quality problems identified in the field surveys conducted as a part of this study.

A. NO-ACTION

The No-Action alternative describes the situation that would occur if EPA elects not to fund any wastewater facilities. Since there are presently no point-source discharges, there would be no obligation under federal regulations for the community to construct sewerage facilities. The 1973 Marion County Sanitary Code would continue to apply to all new private sewage systems and to any existing systems that fail in the future. This would mean that any of the present septic tank systems failing in the future would either be repaired, or replaced by a holding tank. In either case, and also in the case of any new systems installed, all costs would be borne by the individual owner. The Marion County Health Department or the Lake Improvement District could institute more stringent controls over on-site sewerage systems to help improve their performance and reduce potential threats to public health. These measures could include increased inspection and maintenance and water use reduction measures. Holding tank pumping costs could be reduced by using septic tank leach fields for disposal of grey water and holding tanks for the black water wastes only. A dual system such as this would reduce both the hydraulic load on the leach field and the amount of waste discharged to the holding tank. Implementation of such a measure would require approval by the County Sanitarian.

B. FACILITY PLAN PROPOSED PROJECT

This alternative is the project recommended in the Facility Plan. It consists of a conventional gravity collection system serving all existing development in the Lake Improvement District and a force main to pump sewage to the new City of Marion treatment plant, shown on Figure 6. The systems would have sufficient capacity for ultimate development of the planning area. If selected, this alternative would qualify for 75 percent federal funding of the eligible construction costs, which would include a proportional share of the cost of the City of Marion treatment plant. Facilities included in this alternative are described in detail in Chapter I, Section B.

C. DOWN-SIZED FACILITY PLAN PROPOSED PROJECT

This alternative is identical to the previous one except that the project facilities have been reduced in size to reflect the revised population projections developed in this EIS. This will insure comparability with the other alternatives discussed. Changes from the project recommended in the Facility Plan would include reducing the size of the force main and pump stations transporting the wastewater to the City of Marion, and reducing the required treatment capacity at the City of Marion plant. The gravity collection system would remain essentially unchanged because it is already the minimum size allowed under Kansas regulations.

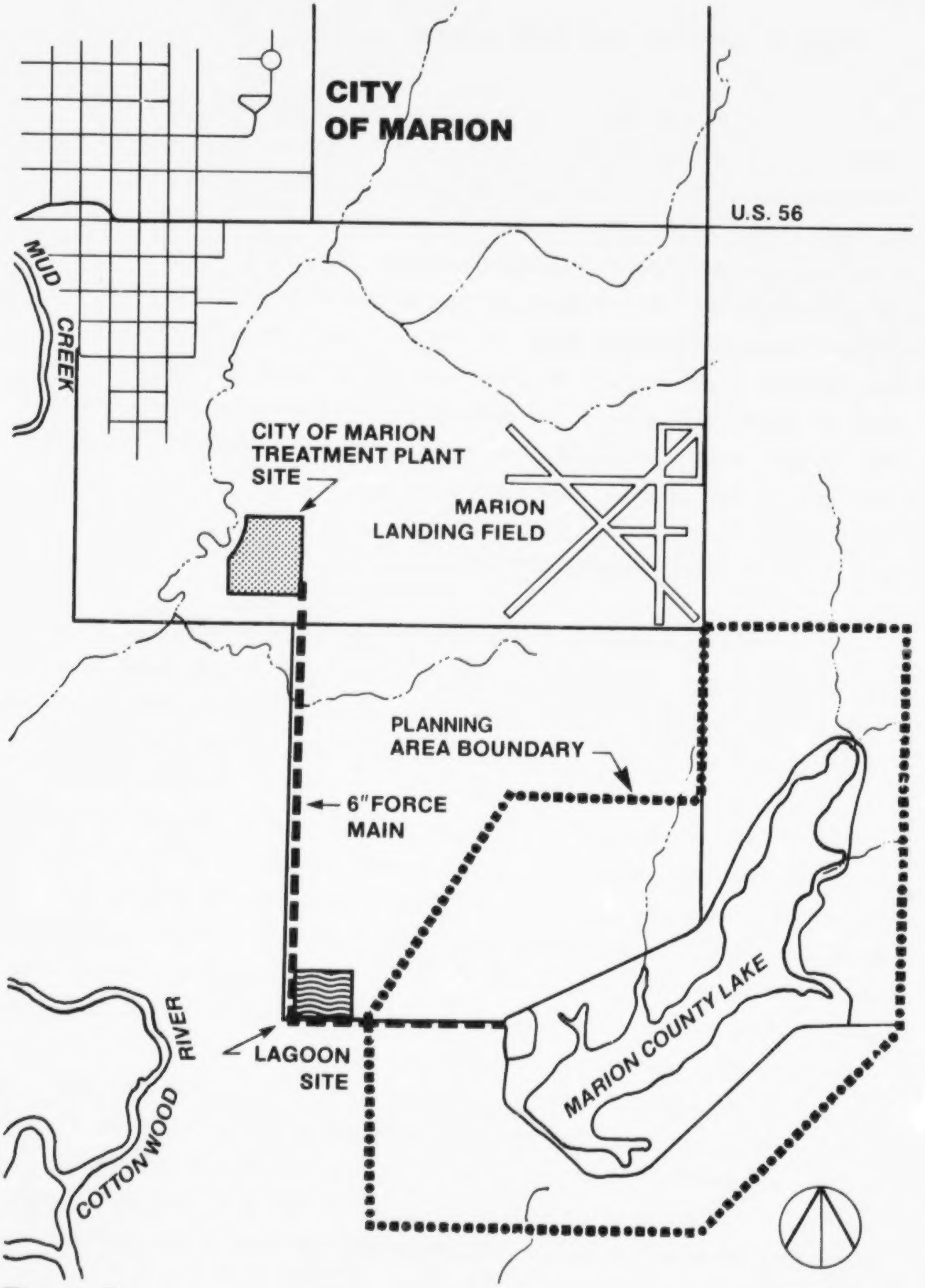

Figure 6
Alternative Treatment Plant Sites

D. DOWN-SIZED TOTAL RETENTION LAGOONS

A conventional gravity collection system with treatment by total retention lagoons was considered and rejected in the Facility Plan because of the large land acquisition and excavation costs. Because of the significant reduction in total yearly wastewater flows due to the revised population projections, the total retention lagoon was reconsidered. Based upon the new design flows presented in Chapter II, a total area of 20 acres would be required for this new alternative. The lagoons would be located approximately 1/2 mile northwest of the dam, as shown on Figure 6. A gravity collection system serving the entire lake community would also be included, and would be identical to those of the previous two alternatives.

E. LIMITED PUBLIC ON-SITE SYSTEM

This alternative would involve the establishment of a special service agency to manage wastewater functions in the planning area. Such an agency would operate under the authority of the Lake Improvement District and the County Health Department, and would be responsible for the issuance of permits, inspection, operation, and maintenance of all on-site systems within the District. The first step in implementing this alternative, after forming the agency itself, would be to correct all identifiable sewerage problems. This action would consist of repairing septic tank systems where physically and economically feasible, and installing holding tanks where necessary. A pumping truck, to be owned and operated by the agency, would be provided to serve these and other holding tanks in the District.

Costs associated with the purchase of the truck and the resolution of all existing sewerage problems would be eligible for an 85 percent federal grant as an "alternative" wastewater treatment system, in accordance with 40 CFR Part 35, Subpart E, Section 35.908. Remaining capital costs, and all operation and maintenance costs, would be borne by the residents of the District. It is presently estimated that 5 holding tanks would have to be installed to alleviate present septic tank problems. Septage pumped from the holding tanks would be discharged to the new City of Marion treatment plant. Separate black water/ grey water systems could also be installed in individual households to reduce holding tank pumping costs.

IV ENVIRONMENTAL CONSEQUENCES

A. WATER QUALITY AND PUBLIC HEALTH

The Construction Grants program was initiated primarily to help local communities abate existing municipal sewerage problems. For this reason, the extent of present water quality and public health problems, and the future impacts of each of the alternatives on these parameters, are major concerns of this EIS.

1. Present Conditions

To establish a baseline for projections of future water quality in the Marion County Lake planning area, EPA conducted extensive field investigations. These investigations included testing water samples from numerous public and private wells and from the lake, a septic leachate survey of the entire lakeshore, and an infrared aerial survey of the planning area to detect failing septic tank leach fields. A geologic investigation of the Marion County Lake area was also conducted to determine the potential relationships between groundwater quality and lake water quality.

a. Water Sampling. On three separate occasions between July and September of 1979, EPA collected and analyzed water samples from the lake area. These included samples from 76 private residences, 3 wells on county park land, and 3 locations in the lake, as shown on Figure 7. The first set of 15 samples were tested for total coliforms only, while the remaining samples were tested for total coliforms, fecal coliforms, and nitrates. The results of these tests are shown in Table 8.

The great majority of water samples analyzed contained very low concentrations of nitrates and fecal coliforms, which would not have been the case if there were contamination of the aquifer by septic tank effluent. Approximately 34 percent of the sites tested showed high concentrations of total coliforms. These can be caused

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TABLE 8
EPA WELL WATER SAMPLING RESULTS

Parameter	Concentration	Number of Samples
Total Coliforms	Less than 1 per 100 milliliters[a]	39
	1 or more per 100 milliliters	21
	Too numerous to count	31
Fecal Coliforms	less than 1 per 100 milliliters	70
	1 or more per 100 milliliters	4
Nitrates	Less than 10 milligrams per liter[b]	76
	Greater than 10 milligrams per liter	1

[a] Concentrations are shown as colonies per 100 milliliters as determined by the membrane filter test. The national drinking water standard for total coliforms in samples examined by this method is: one per 100 milliliters as the arithmetic mean of all samples examined per month; and four per 100 milliliters in more than one sample when less than 20 are examined per month, or four per 100 milliliters in more than five percent of the samples when 20 or more are examined per month.

[b] 10 milligrams per liter is the maximum Nitrate level allowed by EPA primary drinking water regulations for community or non-community water systems.

Note: The water sampling tests presented in this table were performed by EPA personnel on July 18, 1979, September 4, 1979, and September 28, 1979. Not all tests were performed for each sample.

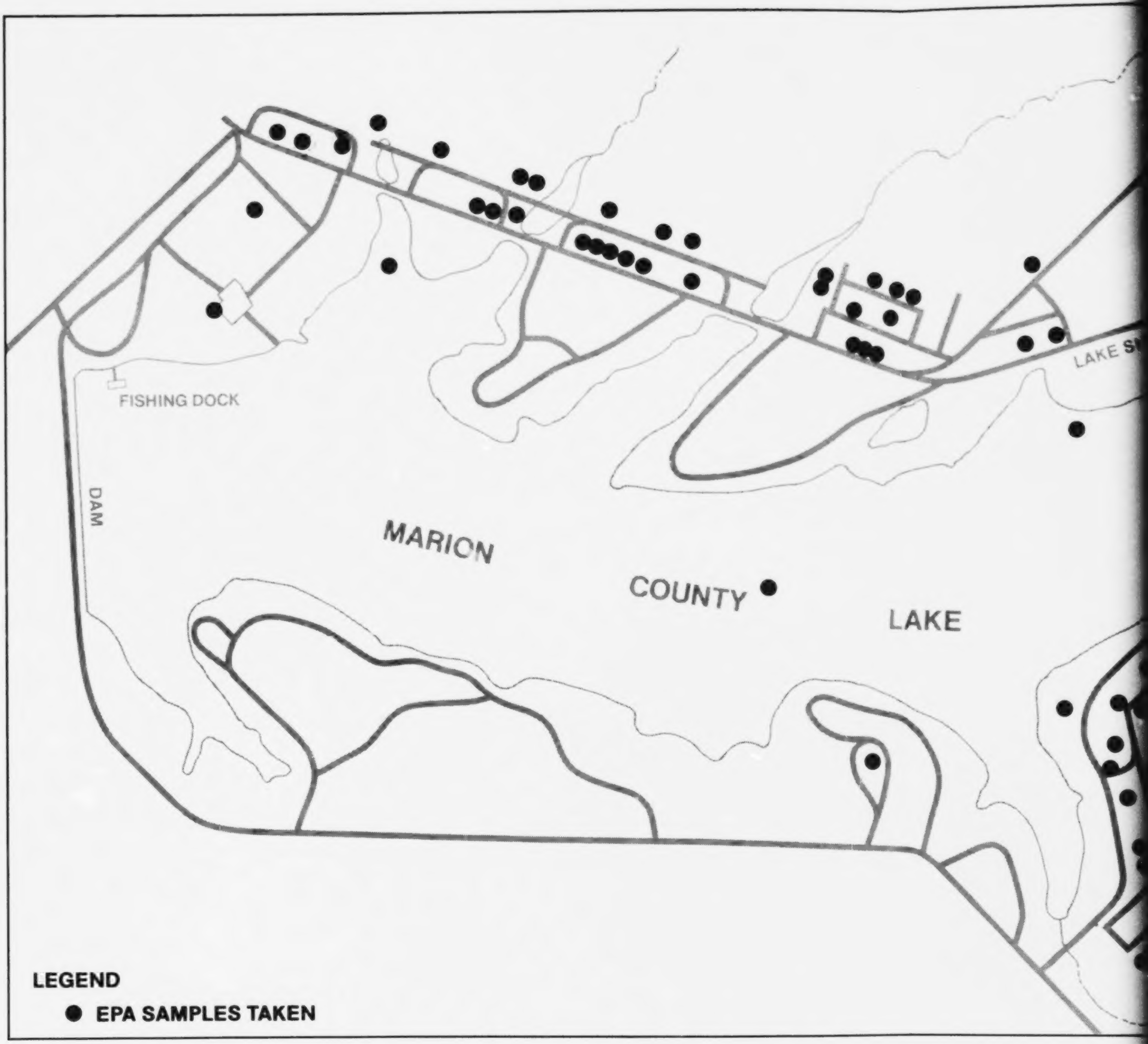
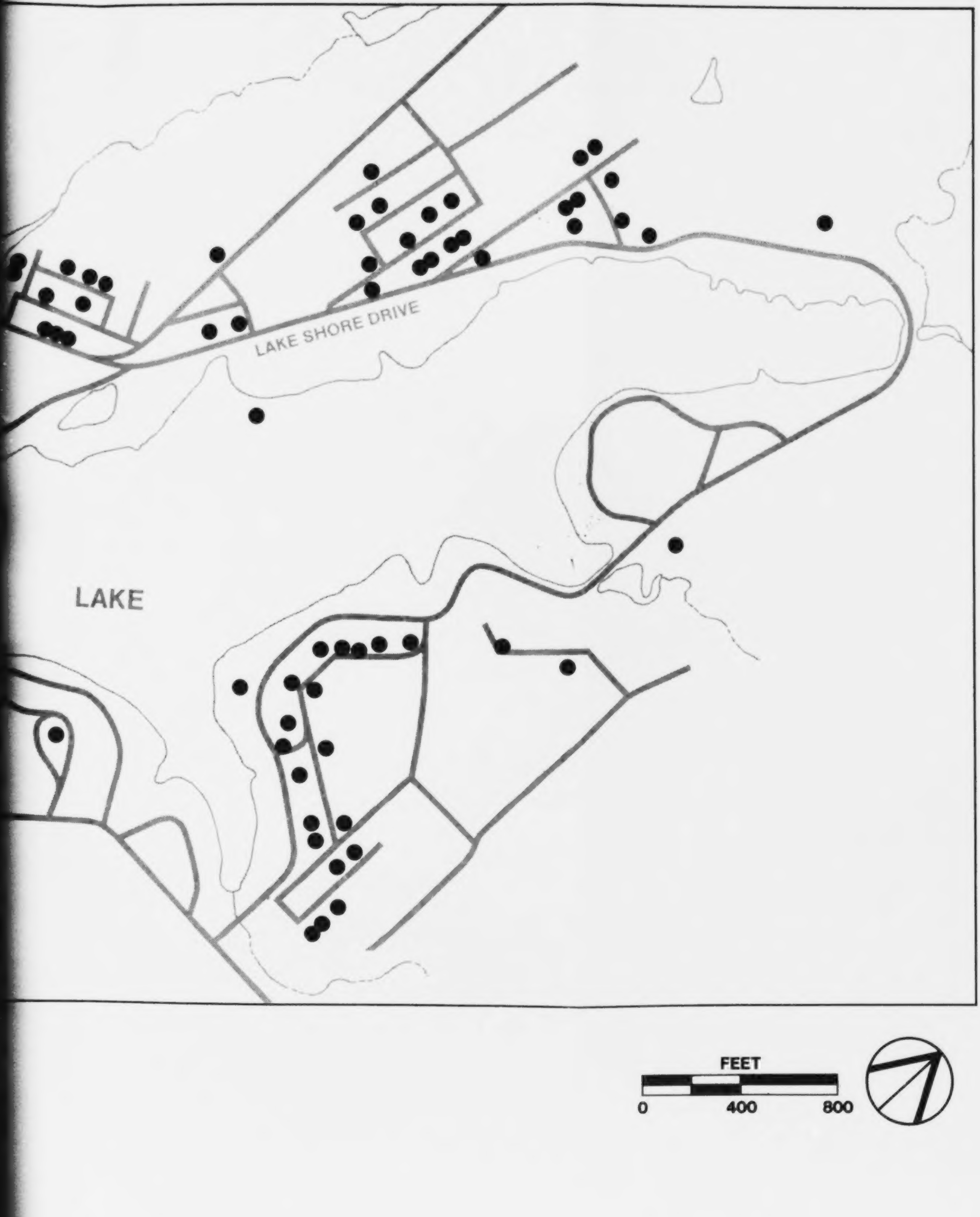


Figure 7
Water Quality Sampling Sites


LAKE SHORE DRIVE
LAKE

FEET
0
400
800

simply by contact with soils, and since the corresponding readings for fecal coliforms and nitrates were generally low, the high total coliform counts are most probably due to poorly sealed wells and deteriorating well casings.

b. Septic Leachate Survey. To locate and measure septic tank leachates entering the lake, EPA contracted with K-V Associates, Inc. to conduct a "septic snooper" survey of the entire lakeshore. The septic snooper device tests the conductivity and fluorescence of the lake water along the shore and, by comparing with known values for the conductivity and fluorescence of the organic matter and chloride ions in local sewage, is able to detect areas where insufficiently treated sewage is entering the lake. The septic leachate survey was conducted at the Marion County Lake on November 18-20, 1979, and detected only slight traces of organics entering the lake. Slightly higher readings were obtained in several of the small coves, but these were attributed to the decomposition of wind-blown leaves and run-off from upstream cattle-grazing areas and did not show the fluorescence characteristics of the local sewage. No indications of human waste were encountered, and the bacterial analysis of cove surface water samples revealed fecal coliform concentrations well below State Class A standards for recreational use. Appendix D contains the complete Septic Leachate Survey Report.

c. Infrared Aerial Survey. Aerial photographs of the entire Marion County Lake planning area were taken by EPA in October of 1979. These photos were taken through an infrared filter to detect slight differences in surface temperature. These temperature variations can be caused by differences in the density and lushness of vegetation, which can, in some instances, be due to enrichment of the soil by septic tank leachate. Over a period of time, the additional nutrients supplied by inadequately treated septic tank effluent will cause a richer vegetative growth along the leach field laterals, and this richer growth can be detected on the infrared aerial photos. This enrichment can also eventually over-fertilize the vegetation, and cause burn-outs, which can also be detected from the aerial survey.

Using these photographic techniques, only three leach fields were identified as possibly failing. Two of these failures had already been detected through on-the-ground inspections by the County Health Department.

d. Geologic Investigation. To determine the potential for contamination of the local groundwater supplies by any possible pollution of surface waters, the geologic structure of the local aquifer was investigated. (See Appendix B). This investigation revealed that wells in the Marion County Lake area are drilled into the top strata of the Towanda Limestone, and that this aquifer is overlain by the Gage Shale member, which is approximately 45 feet thick. Because this shale is relatively impervious, the possiblity of pollution of the aquifer from percolation from septic tank leach fields is unlikely.

The stream that was dammed to form the County Lake had eroded a portion of the Gage Shale, but the well and boring logs for the dam indicate that the Towanda Limestone lies at least 10 to 20 feet below the deepest portion of the lake (See Figure B-1 in Appendix B). It is quite unlikely, therefore, that any pollutants entering the lake could penetrate the remaining portion of the impervious Gage Shale and affect the quality of the aquifer.

The soils of the planning area were also examined for their suitability for septic tank leach fields. In almost all cases, soils in the area were found to have severe limitations for use as leach fields. These ratings are based on very shallow depth to bedrock over most of the area and relatively tight, impermeable soils. In spite of these soils limitations, there have not been a large number of leach field failures in the LID. It is believed that this can be attributed to the very low water usage in the community. Population studies found that there are considerably fewer people in residence on a day-to-day basis than previously thought, and it is likely that few of the seasonal residents have many appliances that are large water users. The higher than normal proportion of elderly among the permanent residents probably also contributes to a low per-capita water use rate.

2. Impacts of the No-Action Alternative

If no federal grant is awarded, it is unlikely that any public sewerage facilities will be built. It is expected that the present County Sanitary Code will continue to be enforced, and that inspections of private systems by the County Health Department will continue. These inspections should detect most problems as the older septic systems fail. Repair of these systems, or replacement with holding tanks as has been occurring over the past several years, should avoid any serious water quality problems.

Future homes built in the District will be required to use holding tanks on lots of less than one acre. Any new septic systems installed will be on lots of one acre or more, ensuring sufficient room for a leach field of adequate size. In general, the inspection and repair of existing on-site systems and proper sizing of future systems should prevent the development of serious water quality problems at the Marion County Lake.

If sewage from the Marion County Lake is not pumped to the City of Marion treatment plant, there will be no additional adverse impacts to the Cottonwood River from discharge of that effluent. This would be a very minor impact in any case.

3. Impacts of Facility Plan Proposed Project or Down-sized Facility Plan Proposed Project

The implementation of either the Facility Plan Proposed Project or the Down-sized Facility Plan Proposed Project will result in the collection and treatment of all sewage generated in the area and will slightly improve water quality in the Marion County Lake. This improvement will come primarily from protection of the lake from future septic system failures, since there is no evidence that present water quality is being degraded. Either of these alternatives would pump the Marion County Lake community's sewage to the proposed Marion City treatment plant, which plans to discharge the treated effluent into the Cottonwood River. Despite treatment before discharge, this addition to the treatment plant's effluent would inevitably degrade the water quality of the Cottonwood River to some small extent.

Construction of the collection system around the entire lake will result in some erosion and siltation in the lake, but this should be a relatively minor, short-term impact and can be reduced by good construction practices.

4. Impacts of Down-sized Total Retention Lagoons

As with the previous alternatives, all sewage from the lake area would be collected and treated outside the community, and therefore the lake water quality would be protected from future pollution from failure of the existing on-site systems. Since there would be no discharge of effluent with this alternative, there would be no adverse impacts to any receiving streams. Construction of the collection system would result in the same short-term erosion and sedimentation impacts mentioned previously. Also, construction of the lagoons on the 20-acre site will result in some erosion problems, although good construction practices should be able to contain most sediment on the site.

5. Impacts of Limited On-Site Public System

The impacts of this alternative would be nearly identical to those of the no-action alternative. The possibility of serious, long-term pollution from the failure of septic tank leach fields would be essentially eliminated by the proposed inspection program and enforced repair or replacement with holding tanks. Since most of the pollutants entering the lake originate from non-point sources, such as cattle-grazing pastures, there would be little improvement over the present water quality conditions. This alternative would, however, prevent any further deterioration of water quality. Since no collection or treatment facilities would be constructed under this alternative, there would be no erosion or sedimentation impacts.

B. POPULATION AND LAND USE IMPACTS

1. No Action Alternative

In general, the residential development of lake property has proceeded without the benefits of zoning, land use planning, or building codes. Prior to 1973, this resulted in the development of many small lots (some only 50' x 100'), each with its own well and septic tank leach field. The small lot sizes did not allow proper sizing of the leach fields or proper separation from water supply wells. Development at the lake ranges from small summer fishing cabins to substantial permanent homes. The extent of present development in the Lake Improvement District is shown on Figure 8.

The 1973 Marion County Sanitary Code has altered the pattern of development by requiring a minimum lot size of at least one acre if a septic tank system will be used. Since 1973, the subdivision of land has mainly been in one-acre lots, as in the Echo Lane subdivision. The pressure to develop lake property has not been great, as evidenced by the substantial number of vacant lots left in subdivisions which have been platted. For example, 39 of 40 platted one-acre lots in the Echo Lane subdivision (platted in 1976) are vacant and 32 of 40 lots are vacant in the Grandview Village subdivision (platted in 1973). Several lots in each subdivision have been purchased, but, as is characteristic of a recreation or retirement community, the property owners are waiting until they can afford to build either a summer home or a retirement home. It is probable that the lack of an adequate public sewerage system has played at least a small part in slowing the rate of development at the lake.

Other recent development has been on unplatted parcels of more than one acre in area, in the northern portion of the LID (NW¼ of Section 10). Several larger parcels (6-15 acres) have been purchased in this area but only one has been subdivided recently (October, 1979), and is now in the process of being platted (58).

If EPA determines not to fund any wastewater facilities, land development and population growth in the LID would continue essentially as it has since the enactment of the 1973 Marion County Sanitary Code. Population growth under these conditions would be expected to follow the projections presented in Chapter II.

2. Facility Plan Proposed Project

The major effect of this plan would be to create a substantial amount of sewered, developable land within the Lake Improvement District. At present, subdivisions are grouped on the eastern and western shores, with large continuous vacant tracts of land north, northwest and south of the lake. By installing a collection system around the lake with sufficient capacity to serve the ultimate population of the LID, a major impediment to development would be removed. In addition, the density at which development could occur on lake property would be greatly increased because the one acre lot size restriction would be removed. The availability of vacant sewered land combined with the ability to develop this land at a high density would be economically more attractive to developers than the present situation. Thus, the implementation of this alternative would create the potential for increased residential development at the lake over and above the population growth projected for the LID in Chapter II. There are, of course, many other factors that affect the demand for residential development at the Lake, and the provision of sewerage facilities would play only a small part in this situation.

An increase in development would not necessarily be advantageous to the LID because of the lack of control over, and planning for, new development. Without adequate land use planning, zoning, or a building code, the LID cannot restrict the location, timing, or density of new subdivisions. Should a significant increase in residential development at the lake occur, it could have adverse impacts on the quality of the recreation environment and the general aesthetics of the lake area. Increases in population would lead to greater

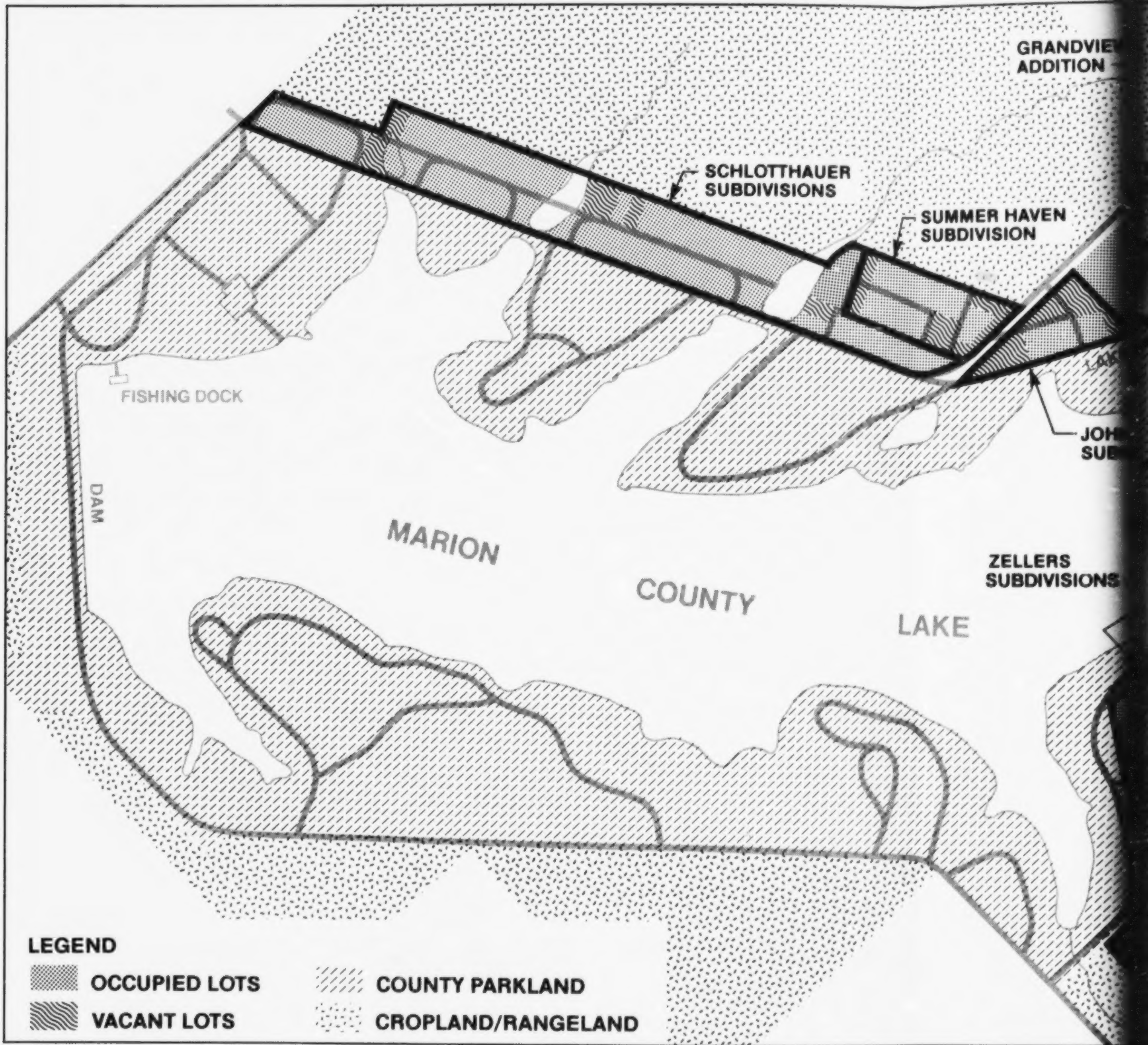
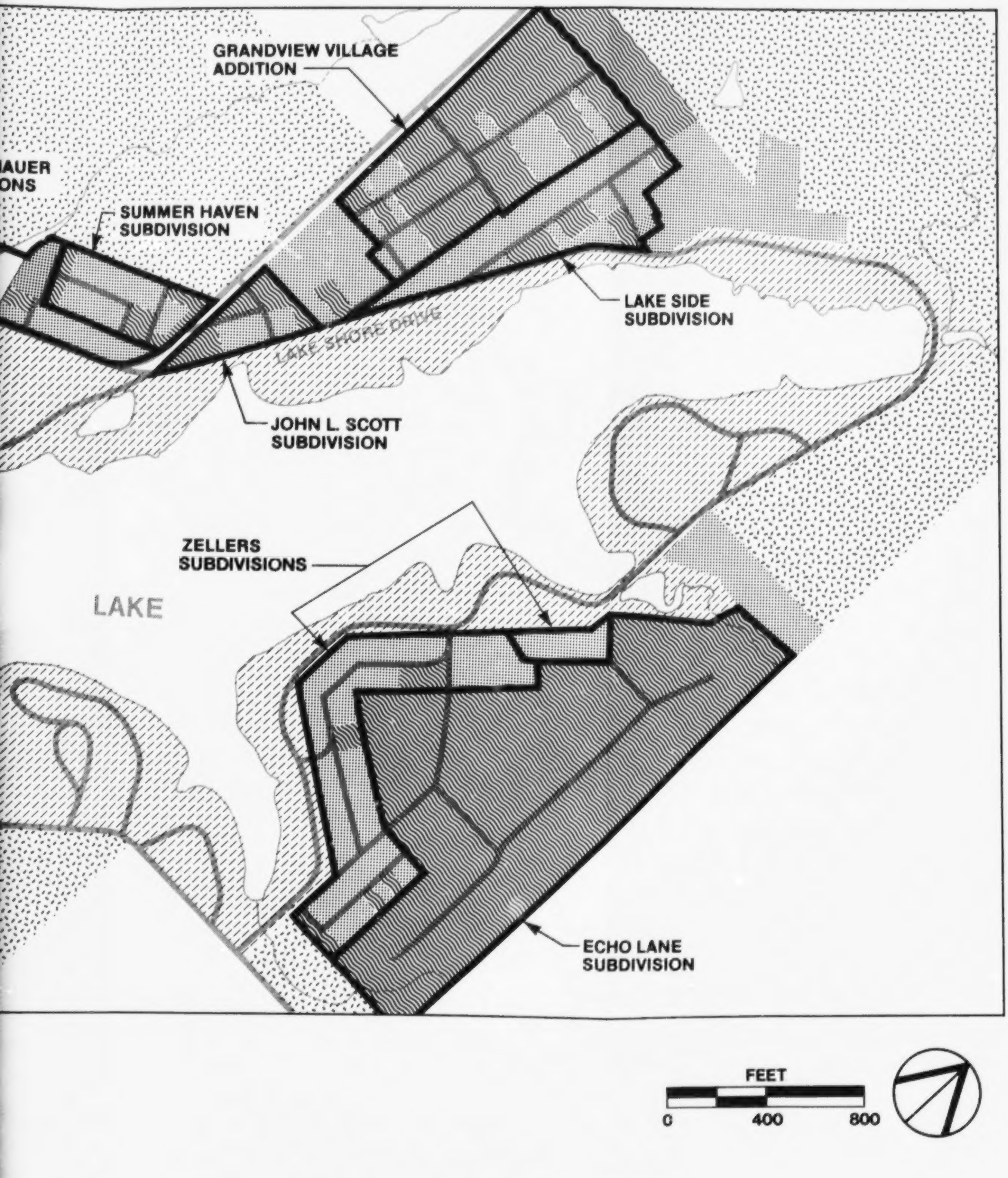


Figure 8
Present Land Use


GRANDVIEW VILLAGE ADDITION
IAUER
ONS
SUMMER HAVEN SUBDIVISION
LAKE SHORE DRIVE
LAKE SIDE SUBDIVISION
JOHN L. SCOTT SUBDIVISION
ZELLERS SUBDIVISIONS
LAKE
ECHO LANE SUBDIVISION
FEET
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800

traffic around the lake, more boating, and more pressure on the lake fishery. This level of development would also reduce the amount of open, undeveloped land which now contributes to the peaceful, rural atmosphere at the Marion County Lake.

3. Down-sized Facility Plan Proposed Project

The impacts associated with this alternative are essentially identical to those described for the Facility Plan proposed project. Although this alternative is a down-sized version of the Facility Plan proposed project, the actual physical size of the collection system would be exactly the same because the collection lines are already designed as small as State regulations will allow. The pump station for this alternative is smaller, but could be enlarged in the future without excessive cost or hardship, and the size of the force main is adequate to handle a substantial increase in flow. Therefore, this alternative's potential to induce growth would be identical to that of the previous alternative.

4. Down-sized Total Retention Lagoons

The impacts on population and land use at the lake that are associated with this alternative would also be primarily the same as those described for the Facility Plan proposed project because the size and extent of the collection system would be the same.

This alternative would require approximately 20 acres of land for the lagoon site. This land is presently used as crop land and would not be considered for other uses in the foreseeable future. The land is of little significance as wildlife habitat in its present state. There is only one residence within the vicinity of the lagoon site which would possibly be adversely affected by the presence of the lagoons.

5. Limited Public On-Site System

Since no collection system would be constructed for this alternative, and since all future development in the LID would be subject to the same restrictions as now exist for sewage facilities, this alternative would have essentially the same impact on land use and population growth as the no-action alternative.

C. COST-EFFECTIVENESS

The cost-effectiveness of each alternative is expressed here as the present value of total cost. Total cost includes all capital, operation and maintenance, administrative, and debt service costs throughout the planning period, less the salvage value of all items with a useful life remaining at the end of the 20-year planning period. No distinction is made here between public and private expenditures because the goal of cost-effective analysis is to determine the true social cost of each alternative--the total amount of resources required by each, which would therefore be unavailable for any other purpose.

Engineering and administrative costs are estimated to be 25% of capital costs, and cover design, construction supervision, legal fees, right-of-way acquisitions, and other administrative expenses. Items for which salvage values are deducted are land, structures, and facilities. Land is assumed to appreciate at a compound annual rate of 3%, while other components are depreciated using the straight-line method (26).

EPA cost-effectiveness guidelines require that each alternative under consideration provide an equivalent level of service. Then, the most cost-effective alternative is the one which achieves that level of service for the lowest present value. In practice, this theoretical requirement is often difficult to meet because of differences among alternatives in the number of persons served or the level of treatment provided. In this instance, all of the EIS alternatives have been sized for the same design year population, and will all provide sufficient protection of public health and lake water quality. These alternatives can therefore be considered comparable for the cost-effective analysis. The Facility Plan Proposed Project alternative was designed for a larger population and is not directly comparable.

TABLE 9
TECHNICAL ASSUMPTIONS OF THE COST-EFFECTIVE ANALYSIS

- All costs are expressed in 1979 dollars
- All unit costs are the most current for the Marion region
- Present value discount (interest) rate = 7 1/8%, as now required by the Water Resources Council
- Planning period = 20 years
- Life of facilities: land - permanent
  structures - 50 years
  mechanical components - 20 years
- Straight-line depreciation on structures and mechanical components, land appreciates at 3% compounded annually
- Land currently valued at $750/acre (27)

TABLE 10
COST-EFFECTIVE ANALYSIS OF ALTERNATIVES

Alternative	Total Present Value
No Action	948,500
Facility Plan Proposed Project*	855,100
Down-Sized Facility Plan Proposed Project	824,300
Down-Sized Total Retention Lagoons	1,357,600
Limited Public On-Site Systems	897,000

*Costs of this alternative are not directly comparable since its design assumes a larger design population.

TABLE 11
COST-EFFECTIVE ANALYSIS SUMMARY

ALTERNATIVE		PRESENT VALUE*				
		Capital Costs -	Salvage Values +	Total O&M Costs =	Total Present Values	Equivalent Annual Values
NO ACTION	Treatment	0	0	948,500	948,500	90,400
FACILITY PLAN PROPOSED PROJECT	Treatment	183,300	21,700	49,300	210,900	20,100
	Collection	646,200	54,500	52,500	644,200	61,400
	Total	829,500	76,200	101,800	855,100	81,500
DOWN-SIZED FACILITY PLAN PROPOSED PROJECT	Treatment	154,600	8,800	45,100	190,900	18,200
	Collection	599,900	19,000	52,500	633,400	60,400
	Total	754,500	27,800	97,600	824,300	78,600
DOWN-SIZED TOTAL RETENTION LAGOONS	Treatment	617,300	8,500	115,400	724,200	69,000
	Collection	599,900	19,000	52,500	633,400	60,400
	Total	1,217,200	27,500	167,900	1,357,600	129,400
LIMITED PUBLIC ON-SITE SYSTEMS	Treatment	241,300	16,200	671,900	897,000	85,500

*All figures rounded to nearest $100.

Technical assumptions of the analysis are listed below in Table 9, and the results are presented in Table 10, which shows that the most cost-effective alternative is the Down-Sized Facility Plan Proposed Project. Although this alternative would involve the least social cost from an overall, national economic perspective, it may not necessarily be the least costly option for the local residents. Details of the cost-effective analysis are presented in Table 11. Background data on the development of the cost estimates for each alternative are presented in Appendix E.

D. LOCAL ECONOMIC IMPACTS

Investment in a wastewater treatment system at Marion County Lake will have short-term and long-term, and direct and indirect economic effects on the Lake Improvement District and its residents.

1. Short-Term Impacts

Minor short-term construction impacts in the form of jobs and incomes will be associated with alternatives 2, 3, and 4. Virtually all of these positive effects will fall outside of the LID, although some residents may be benefitted. The indirect benefits of increased sales by supporting industries would be realized by businesses outside of the LID, and increased tax revenues would be captured almost completely by the city and county governments. Construction of the collection system would produce a small adverse impact in the district if it disrupts camping, hunting, or fishing, and causes a loss of permit revenue.

2. Long-Term Impacts

Long-term economic impacts would be caused by the financial burden of funding the local share of project costs. The local share of costs is determined in accordance with EPA regulations which identify items eligible for federal funding. In general, the eligible items are the capital cost of publicly owned treatment facilities and collection systems. Land costs are generally excluded, as is any portion of the treatment system that is judged to provide excess capacity. Annual operation and maintenance expenses are not eligible for federal funding (28). The local share of total project costs, therefore, includes all of the ineligible capital costs, the local share of the eligible capital costs, and all of the operation and maintenance costs. For those costs identified as eligible, EPA will fund 75% and the local government must provide the remaining 25%. To encourage the development and application of new approaches to wastewater treatment, the EPA will fund 85% of the capital costs of systems that it determines to be "innovative" or "alternative." The Limited Public On-Site System would qualify for increased federal funding as an "alternative" treatment system.

The total capital costs for each alternative, and the federal and local shares, are shown in Table 12. Annual debt service was calculated by assuming that the local capital costs would be amortized over the 20 year planning period at 7.5%, the current average rate for municipal bonds listed in U.S. Financial Data by the St. Louis Federal Reserve Bank. This debt service figure, the annual operation and maintenance cost, and the resulting total yearly cost to the LID of each alternative are listed in Table 13.

The cost of the system to each individual household was calculated by allocating portions of the debt service and the operation and maintenance costs to each property owner. The debt service costs were allocated in equal shares for each sewer connection provided. It is estimated that there would be a total of 230 connections; thus, the owner of a single residence would pay one part in 230 of the total debt service, while Marion County would pay 64 shares of 230, one for each of the connections expected on county land in the trailer park and the camping areas. The operation and maintenance costs were apportioned among all the users of the system based upon the amount of sewage they would be expected to produce. Users were divided into four groups: permanent residents, summer residents, weekend residents, and Marion County. The expected sewage volumes from each group were calculated using the following variables:

- estimated population (see Table A-6 in Appendix A)
- assumed length of stay per year at the lake (see Table A-6 in Appendix A)
- assumed per capita wastewater design flows (see Table 6 in Chapter II)

Marion County's wastewater volume is the sum of the flows from the county trailer park and the 8 privies in the campgrounds. The resulting percentage distribution of the total flow volume was then applied to the total yearly O&M cost of each alternative to determine the O&M component of each user charge under each alternative. Thus seasonal residents would be charged less than year-round residents. Marion County would pay a rate based on all sewage flow expected from trailer occupants, campers, and picnickers. Table 14 presents an estimate of the total user charge per household for 1980 for each of the alternatives.

To evaluate the economic impact that user charges have on the residents of an area, the federal government has developed guidelines to identify sewerage projects likely to have significant adverse impacts on system users (29). These guidelines identify a project as high-cost when the average annual user charges are:

- 1.5% of the median household income in communities with median household incomes less than $6,000
- 2.0% of community median household incomes between $6,000 and $10,000
- 2.5% of community median household incomes greater than $10,000

Several methods of estimating the median household income of the LID place the median income in the $10,000 to $15,000 range. Therefore, if the actual median household income fell at the lower

TABLE 12
CAPITAL COSTS

ALTERNATIVE	TOTAL COST	FEDERAL SHARE	LOCAL SHARE
No Action	$ 0	$ 0	$ 0
Facility Plan Proposed Project	829,500	570,225	259,275
Down-Sized Facility Plan Proposed Project	754,500	515,400	239,100
Down-Sized Total Retention Lagoon	1,217,200	851,175	366,025
Limited Public On-Site Systems	241,300	204,285	37,015

TABLE 13
LOCAL COSTS - 1980

ALTERNATIVE	ANNUAL DEBT SERVICE	ANNUAL OPERATION AND MAINTENANCE	TOTAL YEARLY COST
No Action	$ 0	$ 31,500	$ 31,500
Facility Plan Proposed Project	13,936	9,700	23,636
Down-Sized Facility Plan Proposed Project	12,844	9,300	22,144
Down-Sized Total Retention Lagoon	19,674	16,000	35,674
Limited Public On-Site Systems	1,990	26,200	28,190

TABLE 14
ANNUAL USER CHARGES

ALTERNATIVE	PERMANENT RESIDENTS	SEASONAL RESIDENTS	MARION COUNTY
No Action	$ 230[a]	$ 115[a]	$ 4,725[b]
Facility Plan Proposed Project	129	96	5,525
Down-Sized Facility Plan Proposed Project	121	90	5,145
Down-Sized Total Retention Lagoon	203	144	7,875
Limited Public On-Site Systems	201	104	4,484

[a] User charges for permanent and seasonal residents are presented on a per household basis.

[b] User charges for Marion County include charges for all trailer hook-ups and all park facilities.

boundary of this range, a user charge of $250 would represent a significant financial burden. Since all of the projected user charges are less than this benchmark figure, and since the median income within the district is probably greater than $10,000, none of the alternatives would involve a severe economic impact on the community. Since some lake residents are retirees and may be on fixed incomes, the user charge may have some economic impact on these particular households, but it should not be severe. It should be noted that the cost estimates for alternatives 1 and 5, which both include an increased use of holding tanks, are based upon the same sewage flow rates as the alternatives using conventional collection systems. This is done to provide a comparability in the level of treatment provided among the alternatives. In actual practice, those using holding tanks are generally much more conservative in their use of water, and therefore it is likely that a resident willing to practice such conservation could reduce his costs significantly below those shown for alternatives 1 and 5 in Table 14.

Another alternative for those required to convert from septic tank systems to holding tanks would be the installation of separate plumbing systems for grey water and black water. (Black water is defined as toilet waste only, whereas grey water includes wastewater from the laundry, shower, and sinks.) Black water would be discharged to a holding tank and pumped out for disposal at the Marion treatment plant. The grey water could be discharged to the existing septic tank leach field. This dual system would reduce the hydraulic load on the septic tank system and greatly decrease the number of pathogenic micro-organisms discharged to the leach fields. Since black water comprises only about 35 percent of the wastewater produced in a typical residence, this system would also significantly reduce the amount of wastewater that would be discharged to the holding tank, thereby reducing pump-out costs.

Several factors could have indirect long-term economic impacts on the LID. First, the financial burden of a user charge could cause some amount of displacement if some lower-income households find the charge too costly and choose to move. Similarly, this extra cost could accelerate the trend of converting seasonal units to permanent units as some homeowners find it too expensive to maintain a second home at the lake. It is expected, however, that these effects would be very slight and would occur gradually over a long period of time.

As described in section B of this chapter, the increased development capacity of the LID resulting from a sewage collection system would allow more dense development. This could result in a range of economic impacts, including slightly increased LID revenues because of greater usage of the lake. In order to judge what is most likely to happen, an in-depth analysis of the markets for retirement homes and recreation activities in the region would be necessary.

E. ECOLOGICAL IMPACTS

1. No-Action Alternative

a. Terrestrial Flora. The no-action alternative will not modify the existing vegetation associations in the study area. Marion County is located within the bluestem prairie province of the tall-grass prairie ecoregion (31). The combination of edaphic and climatic conditions at one time supported a diverse grassland community. This community has since been altered by resource practices to the extent that natural grasslands now cover less than one percent of their original range. The project area reflects these conditions in as much as vestiges of native vegetation occur only in the northeast quarter of section 10 (R4E,T20S), along the creek that feeds Marion County Lake from the northeast and along the tailwaters below the dam.

The flora found in the northeast quarter of section 10 is a mixture of native tall-grass prairie species and introduced "weed" species. While it is suspected that this tract of land has not been plowed, the composition and diversity of the existing plant association indicates a history of disturbance from the combined practices of overgrazing and haying. Woody riparian communities are found along the creek bottoms and tailwaters. They are predominately a cottonwood-elm-ash association with other common associates including black willow, mulberry, hackberry, honey locust and boxelder. This type of lowland plains woodland frequently occurs in the narrow belts along river valleys, side drainages and adjacent slopes in central and western Kansas (32).

The remaining native vegetation has been either modified by range management techniques or completely removed by agricultural, urban and other resource practices. An example of such manipulation is through the use of herbicides and fertilizers to selectively enhance certain rangeland species while eliminating others. The cultivation of alfalfa, milo, and winter wheat in the study area has permanently removed the prairie vegetation. Residential housing around the Lake is responsible for both the removal and alteration of the flora by the planting of ornamentals. Many of these introduced species, however, do provide wildlife with a supplementary food supply. Marion County Lake has also inundated acreage once covered by grasslands. Vegetation management practices around the Lake have resulted in a cottonwood parkland. The Lake, nevertheless, has increased the diversity of the fauna and flora in the area because of its availability as a water source in a relatively dry region.

Vegetation that was observed in the project area from October 3-5, 1979 is listed in Appendix C. This included 14 species of trees, 9 shrub and wood vine species, 35 taxa of herbs, and 8 plant taxa that were found growing either on the shoreline or in the Lake. While this inventory of woody and herbaceous autumn flora is by no means complete, it is believed that these species represent the great majority of autumn species.

Due to the time when the field investigation was made, it was not possible to observe and list spring herbaceous flora. Spring species bloom and produce their seeds from late March through late June and then wither or become extremely inconspicuous. Spring flowering species would have at least doubled the vegetation list.

b. Terrestrial Fauna. The no-action alternative should not significantly alter the existing wildlife resources within the project area. Appendix C lists the fish and wildlife species that inhabit the vicinity. This alternative may indirectly benefit wildlife populations, since implementation of a sewage system may encourage development of additional residential area. Such development would subsequently destroy terrestrial wildlife habitat of native rangeland birds and small mammals.

c. Aquatic Flora. Macrophytes (rooted vegetation) are found in the coves and the perimeter of the Lake. These are sometimes suspected to be indicators of eutrophic conditions, but this assumption is not necessarily correct. Macrophytes commonly occur in small impoundments throughout Kansas where suitable habitat, reduced wave action, and warm waters provide optimal conditions for a stable flora (33). Algae (predominately Spirogyra) also were present, but not in the typical abundance of a eutrophic environment. The combined effects of the pondweeds and algae constitute a nuisance to fisherman along the shoreline during the summer and also promote the perpetuation of an overcrowded sunfish population. An attempt to alleviate this problem is being made by stocking grass carp (Ctenopharynodon idella), a species that consumes aquatic vegetation (34). Kansas Fish and Game also has suggested an autumn drawdown water level management plan to control the vegetation.

d. Aquatic Fauna. Field observations, conversations with county lake personnel (34), and available data from the Kansas Fish and Game fishery biologists (35, 36) indicate the water quality in Marion County Lake has not been significantly degraded and is capable of supporting a diverse fish fauna. Presently, black bass and introduced northern pike, species requiring clean, well-oxygenated water are present in large numbers in the Lake. Other species that have been regularly stocked include channel catfish and walleye. No fish kills attributed to nutrient enrichment have been reported by the lake's superintendent or the Kansas Fish and Game Commission. It appears that with regular inspections and proper maintenance, there should be no adverse impact on the ecology of the Lake from continued operation of the existing septic tank systems.

2. Facility Plan Proposed Project

Implementation of the Facility Plan's concept of a collection system at Marion County Lake and pumping the raw sewage to the City of Marion's new treatment facility would have a minor temporary adverse impact on the terrestrial wildlife that inhabit the proposed force main's right-of-way during the construction period. The study area consists mostly of grazed rangeland and cultivated fields of milo and winter wheat. While rangeland provides the proper habitat for most grassland wildlife, farmland is of marginal value, furnishing cover during the growing season and a food source following harvest. The most optimal habitats occur in those areas adjacent to fence rows and between fields. The local wildlife populations should not be encumbered by the construction-related impacts.

There are no unique botanical areas, wetlands, or habitats of state or federal threatened or endangered species (35, 37, 38, 39) that will be affected by proposed project.

The Lake should not be adversely affected by such construction activities as trenching or filling operations. In the event a heavy rain follows trenching operations, the impoundment may suffer a temporary increase in turbidity from the erosion of loose soil. Since the magnitude of the project is small and the construction time-frame is short, the amount of erosion that could occur should not interfere with the ecology of the Lake.

Operational impacts from the additional design capacity load of about 0.105 mgd from Marion County Lake to the city of Marion's treatment plant should be minimal. Marion's proposed treatment plant will be designed to treat 0.526 mgd of sewage and release an effluent of 30 mg/l BOD and 30 mg/l SS. Marion County Lakes's effluent will comprise about 20% of the total volume. If the plant is constructed at the proposed site, the effluent should maintain a constant flow in a presently intermittent tributary of the Cottonwood River, from the outfall site down to the River. It should be expected that this creek will not support a fish fauna and may occasionally create noxious conditions promoted by pools of standing effluent. Because of the dilution capacity of the Cottonwood River, the biota inhabiting the River should not be adversely effected by the effluent. A mixing zone formed at the confluence of the Cottonwood and the tributary should neither significantly disrupt fish movements nor drastically alter the benthic community (40). Beyond the mixing zone, there should be no perceptible long-term adverse impacts to the Cottonwood River. This includes any potential impacts to the Neosho Madtom (Noturus placidus), a state-classified endangered species, and its habitat. This species occurs about 70 miles downstream in the Cottonwood River below John Redmond Reservoir in Coffey County (35).

The secondary impacts of the Marion County Lake project would encourage development of additional residential areas. Such development would subsequently destroy wildlife habitat of native rangeland birds and small mammals.

The Kansas Fish and Game Commission has stated there are no endangered or threatened species known to inhabit the planning area. Migrating species may use the area sporadically; however, no impacts on them are expected.

3. Down-sized Facility Plan Proposed Project

The ecological impacts associated with this alternative would essentially be identical to those discussed in the Facility Plan Proposed Project, except that the total amount of sewage to be treated is estimated to be only 27 percent of the previous design volume.

4. Down-sized Total Retention Lagoons

Lagoon treatment and zero discharge would require the acquisition of about 20 acres of land to retain the effluent. The severity of the long-term adverse impact would be dependent on the location of the lagoon. Since the proposed site is primarily rangeland, the impact to the wildlife by the loss of 20 acres should be minimal. A total retention lagoon system would avoid any of the adverse effects on receiving streams that accompany discharging systems.

5. Limited Public On-site System

Properly operating individual septic systems or holding tanks should have no adverse impact on the ecology of the project area. No wildlife habitat would be destroyed, as all construction would take place on existing residential lots.

F. CULTURAL RESOURCES

A cultural resources reconnaissance survey of the Marion County Lake Improvement District was conducted to identify any archaeological or historic sites that might be adversely affected by the sewerage facility alternatives being considered. This survey was conducted during the summer and fall of 1979 by the Archaeology Laboratory, Wichita State University, under the direction of Dr. Arthur H. Rohn, Principal Investigator.

The investigation included archival searches, informant interviews, and pedestrian surveys of all areas that could be affected by construction of any of the project alternatives. Two small archaeological sites were recorded, neither of which appear to meet the criteria for inclusion on the National Register of Historic Places. These two sites are shown as sites 531 and 532 on Figure 9. (This figure also shows the areas that were investigated in the pedestrian field survey.) No cultural resources were found in any of the force main or interceptor corridors.

Site 532 could potentially be impacted by construction of the City of Marion treatment plant. The site appears to be relatively

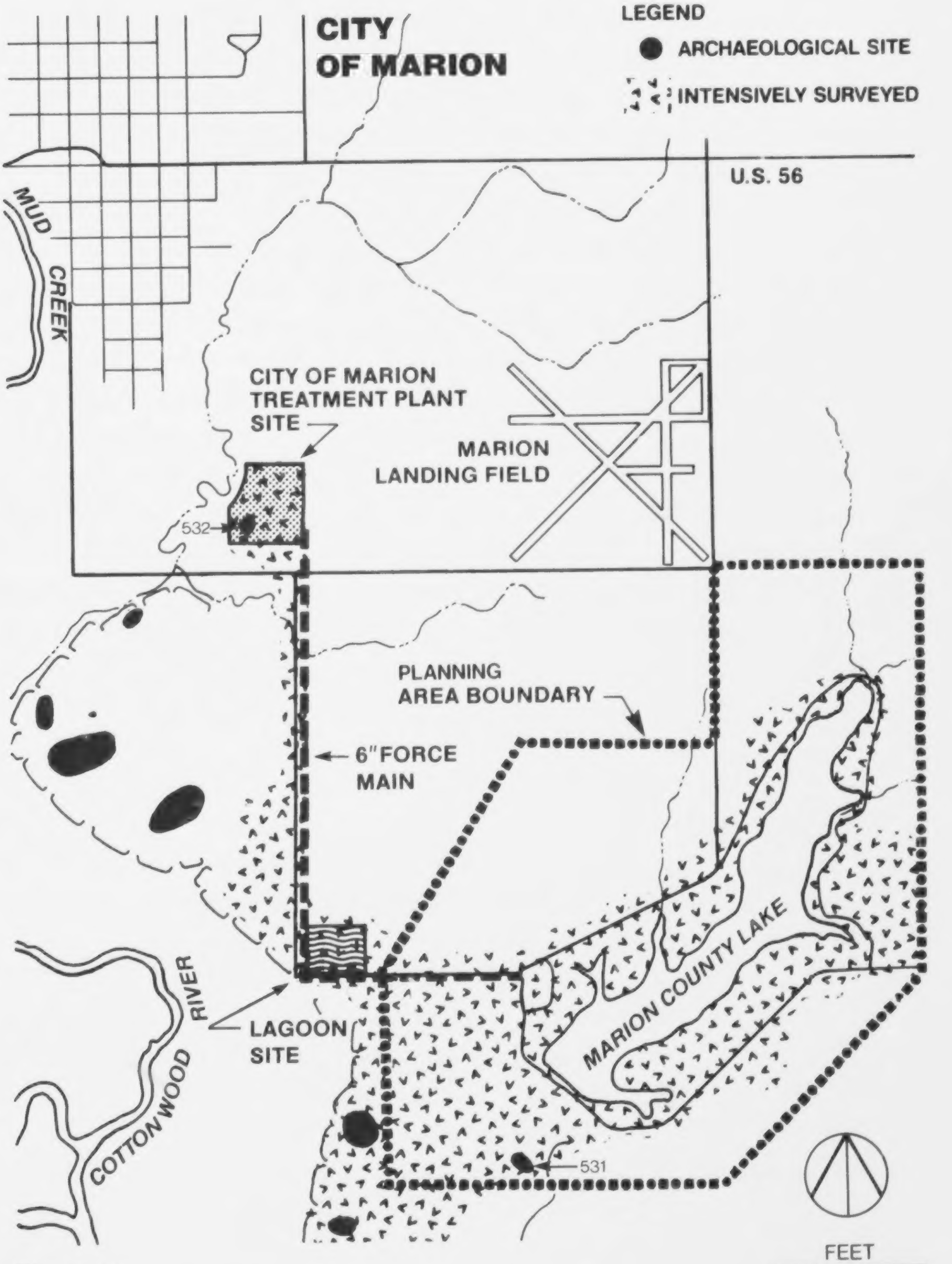

Figure 9
Cultural Resources Reconnaissance Survey

insignificant, but should be salvage tested by hand excavation in one block, with all excavated soil screened to recover a full sample of cultural materials. No cultural affiliation could be determined for this site. Site 531 is located below the Marion County Lake dam and would not be affected by any of the alternatives under consideration. The site appears to represent a pre-Great Bend culture.

The Gee House, a historic house located on Lake Shore Drive, was built in 1877. Because of numerous alterations to the structure, it does not appear to meet the criteria for nomination to the National Register of Historic Places. In any event, none of the alternatives would adversely affect the house.

The Marion County Lake Park represents a fine example of the small scale projects sponsored by President Franklin Roosevelt's New Deal administration in an attempt to counter the Great Depression of the 1930's. However, because it is not sufficiently old, the park does not meet the criteria for designation as a federal, state, or local landmark. Should the present facilities survive another ten years, the lake and park should be reconsidered for landmark status. None of the sewerage alternatives should have direct adverse impacts on the park facilities.

G. SUMMARY OF IMPACTS

Table 15 summarizes the principal impacts that would occur with each of the alternatives. The numbered alternatives presented in the table are defined as follows:

1. No Action
2. Facility Plan Proposed Project
3. Down-sized Facility Plan Proposed Project
4. Down-sized Total Retention Lagoon
5. Limited Public On-Site Systems

Detailed descriptions of these alternatives are presented in Chapter III.

TABLE 15
IMPACT SUMMARY

IMPACT CATEGORY	ALTERNATIVE	IMPACT DESCRIPTION
Lake Water Quality	1, 5	No anticipated impact.
	2, 3, 4	Very minor short-term erosion from construction of collection system.
Stream Water Quality	1, 5	.009 mgd addition to Marion treatment plant effluent discharged to Cottonwood River. Negligible impact.
	2, 3	.028 mgd addition to Marion plant effluent. Negligible impact. Very minor short-term erosion from construction of force main.
	4	No discharge of effluent. Very minor short-term erosion from construction of force main and lagoon.
Groundwater Quality	All	The relatively impervious Gage shale overlying the aquifer prevents pollution of groundwater.
Residential Development	1, 5	All new development must either be on one acre lots or have holding tanks. Provide no new incentives for development.

TABLE 15 (Cont.)
IMPACT SUMMARY

IMPACT CATEGORY	ALTERNATIVE	IMPACT DESCRIPTION
Residential Development	2, 3, 4	Collection system serving the entire lake area could make development more economically attractive. Would allow an increase in density since no limit on lot size would be required. Any growth induced would have minor secondary impacts on open land, noise, traffic, recreation; but growth rate is not expected to vary significantly whether sewers are built or not, since other factors exert more control.
Prime Farmland	1, 5	Should cause no conversion of prime farmlands to other uses.
	2, 3, 4	Potential for induced residential growth could affect a small amount of farmland.
	4 only	Lagoon construction will require 20 acres of prime farmland presently used for grazing.
Cost-Effectiveness		The Down-sized Facility Plant Proposed Project (Alternative 3) was found to be the most cost-effective. The Down-sized Total Retention Lagoon (Alternative 4) was found to be the least cost-effective.
Local User Cost	All	None of the alternatives would place a significant financial burden on the community in general. Any of them, however, may involve some significant impact on lower-income residents.

TABLE 15 (Cont.)
IMPACT SUMMARY

IMPACT CATEGORY	ALTERNATIVE	IMPACT DESCRIPTION
Threatened or Endangered Species	All	There should be no impacts on threatened or endangered species or their habitat.
Aquatic Environment	1, 4, 5	Should have no adverse impacts on aquatic species or habitats.
	2, 3	Nearly negligible impact on species in Cottonwood River by increase in City of Marion plant effluent.
Terrestrial Environment	1, 5	No impacts on the terrestrial environment.
	2, 3, 4	Extremely minor loss of habitat along force main in existing road right-of-way.
	4 only	Minor loss of crop land habitat at 20-acre lagoon site.
Cultural Resources	1, 4, 5	There should be no impacts on cultural resources resulting from implementation of any of these alternatives.
	2, 3	One relatively insignificant archaeological site at the regional treatment plant would be destroyed. Mitigation excavation would be required before construction.

V PUBLIC PARTICIPATION AND COORDINATION

A. PUBLIC PARTICIPATION

The first major public involvement in the proposed project was the public hearing on the Facility Plan. This meeting was held on June 14, 1979, and was attended by approximately 50 residents of the planning area. The Facility Plan consultants summarized the findings of the Plan and answered questions regarding the project schedule and costs. Most sentiments expressed were in favor of quick implementation of the project. Following the consultant's presentation, a representative of the EPA discussed user charges and the need for an inter-governmental agreement between the City of Marion and the Lake Improvement District. A member of the EIS preparation team then briefly outlined the EIS study procedure. The hearing was adjourned after approximately two hours.

The next point of major public involvement was a public workshop on the EIS study. This meeting was held on September 8th, 1979 in the Marion County Lake Meeting Hall. The meeting was held on a Saturday to enable property owners who are at the lake only on weekends to attend. A brief presentation was made by EPA representatives on the EIS process and the various project alternatives being considered. This was followed by a question and answer session touching on a wide variety of subjects. Two members of the EIS study team participated in this workshop, which was attended by approximately 150 local citizens.

In addition to these organized meetings, EPA and EIS study team personnel have been in the Marion County Lake area on several occasions for informal discussions with local citizens and officials.

B. COORDINATION

This EIS has been prepared in coordination with other federal, state, and local agencies concerned with the Marion County Lake area.

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A complete list of all organizations contacted is presented in Table 16. The Kansas Department of Health and Environment; Max Hayen, Marion County Appraiser; Charles Penner, Marion County Health Department; Reiss & Goodness Engineers, and Dale Snelling, Lake Superintendent, were particularly helpful in providing information for this EIS.

TABLE 16

ORGANIZATIONS CONTACTED DURING THE EIS PROCESS

Federal Agencies

- U.S. Army Corps of Engineers
  - Kansas City District
  - Tulsa District
- U.S. Department of Agriculture
  - Soil Conservation Service
- U.S. Department of the Interior
  - Geological Survey
  - National Park Service

State of Kansas

- Department of Health and Environment
- Department of Transportation
- Fish and Game Commission
- Geological Survey
- State Historical Society
- Water Resources Board

Regional Agencies

- Flint Hills Regional Council
- City of Wichita Planning Department

Marion County

Assessor's Office
Commissioners
Engineer
Health Department
Planning Commission

Local Agencies

Marion County Lake Improvement District
City of Marion
Marion Chamber of Commerce

Private Concerns

Bethel College Biology Department, Dwight Platt, Ph.D.
Case & Sons Insurance
Davis Septic Tank Service
Don's Plumbing
Flint Hills Rural Electric Cooperative Association
Kansas Power & Light
Moser & Associates
Prewit Septic Tank Service
Reiss & Goodness Engineers
Save the Tall Grass Prairie, Inc.

VI CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

In an attempt to determine the extent of water quality problems in the Marion County Lake Improvement District, EPA performed a variety of investigations. Water samples from a large number of private and public water supplies were tested for indications of sewage pollution; infrared aerial photos of the entire area were taken to detect surface evidence of septic tank leach field failures; and, a septic leachate survey of the entire lakeshore was performed to determine if insufficiently treated sewage was entering the lake from improperly operating leach fields. The methodologies used in these tests and the results are presented in Chapter IV.

Based upon the results of this series of tests, EPA has determined that no significant health hazards or water quality problems presently exist at the Marion County Lake. Because the Construction Grants program was established primarily to assist local communities in dealing with existing sewage problems, the construction of sewerage facilities at the lake is considered to be ineligible for federal assistance under this program. If, at some future time, there is a change in water quality conditions, the Improvement District could submit another application for federal assistance. The following section outlines other actions that could be taken now to safeguard the existing water quality and to deal with future water quality problems as they arise.

B. RECOMMENDATIONS

The Lake Improvement District could construct the proposed project, or any of the other alternatives considered, without federal assistance. This would, however, pose extreme financial hardships for many property owners in the District, and would result in very little improvement in the existing water quality. A more reasonable approach would consist of public and individual actions to improve the operation and reliability of existing and future on-site systems.

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One such measure could involve an agreement between the Lake Improvement District and the County Health Department to establish a regular schedule of detailed inspections of all sewerage systems in the District. This practice would reduce the possiblity of septic tank leach field failures going unnoticed over long periods of time. The County Health Department might also require that percolation tests be performed only by independent, approved persons, such as members of the department or registered engineers, and that all septic tanks be inspected during installation.

Individuals in the District could extend the operating life of their leach field systems and reduce the expense of pumping their holding tanks by reducing their water consumption. A number of devices are available that involve neither increased maintenance nor any changes in water use habits. These include shower head flow controls, dual cycle or other low-volume toilets, and lavatory faucet flow control devices.

It might also be possible to establish through the County Health Department a program of technical information and assistance to install grey water systems that would help prevent hydraulic overloading of septic tank systems and reduce by approximately 65 percent the amount of wastewater discharged to holding tanks.

LIST OF PREPARERS

This Environmental Impact Statement was prepared by Sverdrup & Parcel and Associates, Inc. for the U.S. Environmental Protection Agency, Region VII, under the guidance of Norm Crisp, EPA EIS Project Monitor and Deborah Mau, EPA Project Engineer, Construction Grants Branch. Principal personnel for Sverdrup & Parcel and their areas of responsibility are listed below.

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GLOSSARY

Absorption field - a system of buried, perforated or discontinuous pipes (laterals) through which partially treated wastewater leaving a septic tank is distributed over an area for further treatment by percolation into the soil; same as "adsorption field," "lateral field," or "leach field."

Adsorption field - an absorption field.

Aerobic - requiring the presence of free elemental oxygen.

Alternative wastewater treatment systems - wastewater conveyance and/or treatment systems other than conventional, centralized systems. They include septic tanks and drain fields, other on-site systems, cluster systems, and small diameter collection systems, as defined in 40 CFR 35, Appendix E.

Anaerobic - requiring the absence of free elemental oxygen.

Aquifer - an underground, water-bearing stratum of permeable rock, sand, or gravel.

Alluvial - relating to material deposited by a stream.

Avian - of, pertaining to, or relating to birds.

Benthos - organisms dwelling on the bottom of a water body. The benthos includes all organisms which crawl on, burrow into, or grow attached to, the bottom.

Biochemical oxygen demand (BOD) - the quantity of oxygen used in the biochemical decompositon of organic matter; used to indicate the amount of organic matter present in water; BOD_5 refers to a biochemical oxygen demand reading taken from a test in which a water sample is incubated with bacteria for 5 days.

Biota - the plants and animals of an area, taken collectively.

Calcareous - any substance that contains calcium carbonate.

Carbon monoxide - odorless, toxic gas contributing to air pollution, released mainly by motor vehicles.

cfs - cubic feet per second.

Chemical oxygen demand (COD) - a measure of the oxygen-consuming capacity of inorganic and organic matter present in water or wastewater.

Chert - a hard, extremely dense sedimentary rock consisting primarily of cryptocrystalline silica; mostly semi-vitreous and usually occurring as nodules or concretions in limestone and dolomite.

Chlorination - disinfection of water by treatment with chlorine.

Claypan - a dense, heavy, and relatively impervious subsurface soil layer that owes its hardness to a relatively higher clay content than that of the overlying material; also "hardpan."

Clean Water Act - federal law passed in 1977 revising Federal Water Pollution Control Act Amendments of 1972; pertinent sections are 201, 208, and 303 (e).

Cluster system - wastewater treatment system in which effluent from several individual septic tanks is collected and treated further in a community absorption field, rather than in individual fields.

Coliform - a group of bacteria which includes organisms found on plants, in soils, and in human and animal feces; their presence is used as an indicator of water pollution.

Colluvial - pertaining to a loose, heterogeneous, incoherent mass of soil material or rock fragments deposited by mass-wasting; usually at the bottom of a cliff or steep slope.

Comminutor - a device that grinds solids in wastewater prior to other treatment.

Complete-mix activated sludge system - a biological wastewater treatment process in which a mixture of wastewater and bacteria is agitated and mechanically aerated, allowing bacterial decomposition of waste solids; bacteria and remaining solids are subsequently separated from the treated wastewater by settling and wasted or returned to the process as needed.

Construction Grants Program - a program administered by EPA to carry out the mandate of the Clean Water Act to assist local communities in funding municipal wastewater facilities.

Deciduous forest - an association of trees that shed their foliage at the end of a growing season.

Design flow - the volume of wastewater a facility is expected to process in a given length of time; usually the average daily amount of wastewater expected to be produced in a facility's service area 20 years after its construction.

Differential settlement - non-uniform settlement of a geologic formation or soil.

Dip - the angle that a structural geologic surface makes with the horizontal, measured perpendicular to the line formed by the intersection of the surface with the horizontal.

Drift - a general term applied to all rock material transported by a glacier and deposited directly by or from the ice, or by running water emanating from a glacier.

Ecosystem - a system formed by the interaction of a group of organisms and their environment.

Ecoregion - a geographical area over which the environmental complex, produced by climate, topography, and soil, is sufficiently uniform to permit development of characteristic types of ecologic associations.

Edaphic - pertaining to the soil.

Effluent - wastewater discharged from a facility or one of its components.

EIS - Environmental Impact Statement.

EPA - U. S. Environmental Protection Agency.

Escarpment - a long, continous cliff or steep slope facing in one general direction.

Eutrophication - the process of maturation of a lake from nutrient-poor to nutrient-rich. The artificial addition of nutrients to lakes accelerates the process.

Extended aeration - a complete-mix activiated sludge system in which the amount of influent wastes is relatively small compared to the amount of bacteria in the system, requiring longer detention times than conventional complete-mix activated sludge processes and resulting in less sludge wastes.

Facilities Plan - a preliminary engineering report on proposed wastewater treatment facilities; developed to fulfill Step 1 requirements of EPA's Construction Grants program; analyzes treatment needs, alternative treatment methods, existing sewer system adequacy, and costs; includes an environmental assessment; also referred to as a "201 plan."

Fault - a surface or rock fracture along which there has been displacement.

Fauna - the animal life of an area.

Fecal coliform - group of bacteria present in human and animal intestines and excreted in feces; while harmless in themselves, fecal coliforms may indicate the presence of pathogens.

Flaggy - tending to split into layers of suitable thickness for use as flagstones; layered bedding 1 to 10 cm. in thickness.

Flood plain - the land adjacent to a river channel that is covered with water when the river overflows its banks.

Flora - the plant life of an area.

Fold - a curve or bend of a flat structure or structures such as rock strata.

Force main - a sewer through which wastewater is pumped.

gpcd - gallons per capita per day.

gpd - gallons per day

gpm - gallons per minute

gpy - gallons per year.

Gravity sewer - a sewer in which the wastewater flows downhill from source to outlet, with no pumping required.

Grit chamber - initial phase of primary treatment in which large solids - generally inorganic ones - are removed.

Habitat - the place where an organism lives.

Holding tank - a large tank (typically 1000-1500 gallons) used to store wastewater until it can be collected by a pump truck (honeywagon) for transport to a treatment plant.

Honeywagon - a tank truck used for transporting raw wastewater or septage.

I/I - the combined extraneous wastewater flow from infiltration and inflow.

Infiltration - (1) movement of water downward into the soil; (2) water entering a sewer system underground by such means as cracks in sewer pipes and manholes and leaky pipe joints, usually caused by a water table above the level of the sewer.

Inflow - water other than sewage entering a sewer system directly by such means as connections with storm sewers, roof and foundation drains, sump pumps, and holes in manhole covers.

Influent - wastewater entering a wastewater facility or component thereof.

Infrared - referring to radiation with wavelengths longer than those of red light; while invisible to the human eye, some photographic film is sensitive to it, and, when developed, indicates differences in heat production by the objects photographed; such film can be used in aerial photography to detect septic system activity near the ground surface.

Innovative wastewater treatment systems - methods of wastewater treatment not fully proven under the circumstances of their contemplated use, and that represent a significant advancement over the state of the art in terms of water conservation, reclamation, reuse, energy recovery, or cost reduction, as defined in 40 CFR 35, Appendix E.

Interceptor sewer - a sewer receiving flows from collector lines and carrying them to a central point for treatment and discharge.

Intermittent stream - a stream or a reach of a stream that flows only at certain times of the year.

Interstice - an opening or space, as in rock or soil.

Joint - a surface of actual or potential fracture or parting in a rock, without displacement.

KSA - Kansas Statutes Annotated, the codified laws of the State of Kansas.

Lagoon - a large pond in which wastewater is retained for primary and/or secondary treatment; discharging lagoons produce an effluent that according to Kansas law must contain no more than 30 mg/l BOD_5 and 80 mg/l suspended solids; non-discharging lagoons rely on evaporation for disposal of water.

Land application - wastewater treatment by the action of bacteria present in the soil following its application onto the surface of the ground; accomplished by overland flow, rapid infiltration, or slow infiltration; in Kansas, land application must be preceded by 90 days' storage.

Lateral field - absorption field for a septic tank.

Leach field - absorption field for a septic tank.

Leaching - the separation, selective removal, or dissolution of soluble constituents from a layer of rock or soil horizon by the action of percolating water; the similar removal of pollutants from wastewater percolating through soil by filtering and microbial processes.

LID - Marion County Lake Improvement District

Lift station - a small wastewater pumping station that lifts wastewater to a higher elevation when the continuance of the gravity sewer at reasonable slopes would involve excessive depths of trench.

Limestone - a carbonate sedimentary rock containing more than 95% calcite and less than 5% dolomite.

Loess - a shallowly buried layer of windblown dust of relatively recent geologic age; generally nonstratified, porous, unconsolidated and fine-grained, consisting predominantly of silt.

Macrophytes - aquatic plants possessing a multi-cellular structure with cells differentiated into specialized tissues. Their sizes range from near microscopic, e.g., duckweed, to massive cypress trees. Macrophytes can be divided into three major growth types: floating, submerged, or emersed.

Macroscopic - large enough to be perceived or examined by the unaided eye.

mgd - million gallons per day

mg/l - miligrams per liter; approximately equivalent to parts per million.

Mitigating measure - action taken to lessen or eliminate an adverse environmental impact.

Mixing zone - that portion of a stream from the point at which effluent is introduced, downstream to the point at which it is uniformly mixed with the receiving waters.

Multi-media filtration - process of passing water through a series of substances, usually some sort of granular material, for removal of suspended solids.

NEPA - National Environmental Policy Act of 1969.

Nitrite - substance released by some soil bacteria, toxic to many organisms and usually rapidly converted by other bacteria to nitrate, which is not toxic.

Nitrogen dioxide - toxic, corrosive, reddish-orange gas released into the atmosphere mainly through combustion of natural gas and coal and exhaust from motor vehicles.

Non-point-source discharge - general source of pollution not originating from a single controllable source, e.g., runoff from farmland.

Notice of Intent - announcement by a federal agency of its intent to prepare an EIS.

NPDES - National Pollutant Discharge Elimination System.

On-site systems - wastewater treatment systems in which the treatment is performed on the site where the wastes are produced. Examples include septic tanks with leach fields, composting toilets, etc.

Overland flow - method of land application in which wastewater is allowed to run down a grassy slope; treatment is by aerobic soil bacteria and plant uptake of nutrients; runoff is collected and discharged.

Package plant - a small wastewater treatment plant whose various components are contained within one structure, purchased and installed as a unit.

Particulates - minute, separate particles dispersed in the air, contributing to pollution; main sources are coal combustion, industrial processes, and forest fires.

Pathogen - disease-producing organism.

Percolation - movement of water through soil; empirically measured by a test in which a hole is drilled in the soil and soaked, then filled with water, and the rate of downward movement of the water surface recorded, given in minutes per inch; does not necessarily correllate directly to permeability.

Perennial stream - a stream or a reach of a stream that flows continuously throughout the year.

Permeability - quality of soil that permits it to transmit water; empirically measured by rate of downward movement of water through saturated soil cores; given in inches per hour; does not necessarily correllate directly to percolation.

pH - a measurement of hydrogen ion concentration; used as an expression of acidity and alkalinity on a scale whose values run from 0 to 14, with 7 representing neutrality, numbers from 7 to 0 increasing acidity, and numbers greater than 7 increasing alkalinity.

Physiographic province - any large geologic area or region considered as a whole, all parts of which are characterized by similar landform features or history, and differ significantly from those of adjacent areas.

Planning area - area covered by a Facilities Plan.

ppm - parts per million; approximately equivalent to milligrams per liter.

Point-source discharge - introduction of treated or untreated wastewater into a body of water at a discrete point of discharge, such as a pipe.

Primary impact - direct effect of an action.

Primary treatment - the first major process in most wastewater treatment plants; consisting of retaining wastewater in a tank long enough for solids to settle.

Prime agricultural land - land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and that is available for one of these uses; rated in Class I or II in SCS's agricultural capability classification system.

Privy - a small building fixed directly over a pit or vault, equipped with seating and used for collection of bodily wastes.

Province - an area that corresponds to a broad vegetation region, and that has uniform regional climate and the same type or types of zonal soils.

PVC - polyvinylchloride, a type of plastic from which some sewer pipe is made.

Range - land producing naturalized or native forage for animal consumption, and lands that are revegetated naturally or artificially to provide a forage cover that is managed like naturalized or native vegetation.

Rapid infiltration - a method of land application in which wastewater is sprayed onto a flat area with sandy (highly permeable) soils.

RCP - Reinforced Concrete Pipe; frequently used for large-diameter sewers.

Riparian woodland - an area of trees and other woody vegetation bordering a stream or lake.

Sandstone - a medium-grained sedimentary rock composed of sand-sized particles which are united by a cementing material.

Screen - a device with openings, generally of uniform size, used to retain or remove solids from wastewater.

SCS - Soil Conservation Service, a branch of the U.S. Department of Agriculture.

Secondary impact - an indirect effect of an action; for example, population growth induced by the existence of a proposed project.

Secondary treatment - removal of organic wastewater constituents, usually by microbial activity, following primary treatment (settling); a plant is recognized as providing secondary treatment if its effluent contains no more than 30 mg/l each of BOD_5 and suspended solids, or if at least 85% of BOD_5 and suspended solids are removed from the effluent, whichever is the stricter standard.

Section 201 - portion of Clean Water Act providing for federal assistance in the construction of municipal wastewater facilities.

Section 208 - portion of Clean Water Act providing for federal assistance in water quality management planning for counties or multiple-county areas; 208 plans are used to guide all county water pollution control efforts in accordance with federal, state, and local requirements.

Section 303(e) - section of Clean Water Act mandating continuous statewide water quality planning.

Sedimentation basin - a basin or tank in which wastewater is retained to allow suspended matter to settle out.

Septage - the accumulated scum and sludge from septic tanks or holding tanks.

Septic Snooper - a septic leachate detection instrument consisting of an underwater probe, a water intake system, an analyzer control unit, and a graphic recorder. Water from near the lakeshore is drawn through the instrument and continuously analyzed for specific fluorescence and conductivity. When calibrated against typical effluents, the instrument can detect and profile effluent-like substances and thereby locate septic tank leachate or other sources of domestic sewage entering the water body.

Septic tank - a component for partial on-site treatment of wastewater, usually for individual residences, by means of settling and decomposition by anaerobic microorganisms; must be paired with an absorption field for complete treatment.

Septic tank system - wastewater treatment system consisting of a septic tank and absorption field.

Service area - area intended to be served by a given wastewater facility.

Service - a single pipe, gate, valve, or similar means of connecting a water or sewer main with a house.

Shale - a fine-grained sedimentary rock formed by the consolidation of clay, silt, or mud, and characterized by a finely stratified structure.

Siliceous - rock containing abundant silica, especially free silica, such as quartz or chert.

Siltation - the accumulation by deposition of silt in a body of water.

Siltstone - a rock whose composition is intermediate between those of sandstone and shale.

Slow infiltration - method of land application in which wastewater is sprayed onto a flat area with silty or clayey (moderately permeable) soils; Kansas requires that the receiving area be cultivated.

Sludge - accumulated solids separated from liquids, such as water or wastewater, during treatment or processing.

Species - any group of fish, wildlife or plants which interbreeds when mature.

Species diversity - the number of different species occurring in some location or under some condition.

Step 1 - first stage of a project funded under EPA's Construction Grants program: development of a Facilities Plan.

Step 2 - second stage of a project funded under EPA's Construction Grants program: development of design drawings and specifications.

Step 3 - third stage of a project funded under EPA's Construction Grants program: construction.

Stratum (plural, strata) - a sedimentary bed or layer, visually separable from other layers.

Suspended solids (SS) - particles dispersed within, but not dissolved in, wastewater; if water is allowed to stand, suspended matter will eventually float to the top or settle to the bottom; dissolved matter (for instance, table salt or sugar) will not.

Synergism - cooperative action of discrete agents such that the total effect is greater than the sum of the effects taken independently.

Taxa (plural of taxon) - a group of organisms constituting one of the categories or formal units in taxonomic classification, such as phylum, order, family, genus, or species, and characterized by attributes in varying degrees of distinction.

Terrace - a large, step-like ledge breaking the continuity of a slope.

Turbidity - cloudiness of water brought about by the presence of silt or other suspended solids.

TSS - total suspended solids, see "suspended solids."

Upland forest - a plant community consisting predominantly of trees and other woody vegetation, found in the higher parts of a region or tract of land.

USDA - United States Department of Agriculture.

Uplift - a structurally high area produced by positive movements that raise or upthrust rocks, as in a dome.

Variance - a license to do some act contrary to the usual rule, generally applying here to a zoning ordinance.

VCP - Vitrified Clay Pipe; the most common type of sewer pipe.

Waste stabilization pond - a lagoon.

APPENDIX A

POPULATION PROJECTIONS

In the course of field investigations for this EIS, several data sources were consulted that seemed to indicate that estimating present and future populations in the Lake Improvement District was a more complex problem than it appeared in the Facility Plan. In particular, the problems associated with wastewater flows contributed by the many seasonal and weekend residents were apparently not addressed. This fact becomes important in analyzing yearly wastewater flows for total retention lagoon alternatives, and bears on all other alternatives to some extent. This Appendix presents a more detailed investigation of population in the LID using data gathered from a variety of sources, including the Marion County Appraiser's Office, records of the two electric companies serving the LID, and interviews with the Lake Superintendent.

In general, the reliability of projections of growth for small populations is always somewhat suspect. It is felt, however, that the projections presented in this EIS are based upon the best available data and reasonable assumptions and should provide a conservative basis for design.

1. Present Population

The population at the LID is composed of several groups, differentiated by the amount of time each year that the group resides at the lake and whether members in the group use the LID as their permament or seasonal home or simply as a weekend recreational resource. Each group was evaluated in order to determine their specific characteristics. A summary of this evaluation follows.

a. Permanent Residents. This group includes those persons who own homes and reside at the lake on a year-round basis. The majority of these permanent residents are retired (41). According to the latest figures available from the Marion County Appraiser's Office, there are currently 67 residences in the Lake Improvement District occupied on a year-round basis by 143 persons. Thus the present average persons per household figure is 2.13, which reflects the low number of children expected in a retirement community. Permanent residents are assumed to reside at the lake 365 days per year.

b. Seasonal Residents. This group includes those persons who own vacation homes in the LID. The types of seasonal units range from mobile homes and unimproved cabins to larger single-family cottages. Several cabins are no more than fishing shacks with privies and are scarcely used (42). Generally, the people owning summer and/or weekend homes have families with children or they are older couples who now are planning to make their seasonal home their retirement home in the future.

Assuming that the difference between the total number of dwelling units (see Table A-1) and the number of permanent units represents the number of seasonal units, there are presently 99 seasonal units at the lake. The large majority of seasonal residents have permanent homes in Wichita, so the average persons per household figure for the Wichita SMSA, 3.06 (43), was applied to the number of seasonal units, yielding an estimated 303 (99 x 3.06) seasonal residents within the LID.

According to records of monthly electrical usage, approximately 60% of the seasonal residents are continually in residence from April through November, or 240 days per year. The other 40% reside there an average of two weekends per month, year-round, or 48 days per year (44).

c. Campers. There are approximately one hundred (100) campsites that are used on the 21 non-holiday weekends between May and October, while three hundred campsites are used during the four-day holiday weekends (Memorial Day, Fourth of July and Labor Day) (45). At 3.5 persons per campsite, (the average number of persons per campsite estimated by the Corps of Engineers at the Marion Reservoir), the average number of campers camping at the Lake on holiday and regular weekends from May to October is assumed to be 1050 and 350, respectively.

TABLE A-1
DWELLING UNIT AND POPULATION DATA

Year	Total[a] Units	Permanent[a] Units	Permanent[a] Population	Seasonal[b] Units	Seasonal[c] Population
1969	149	35	79	114	349
1970	150	32	71	118	361
1971	154	37	82	117	358
1972	155	45	107	110	337
1973	155	50	112	105	321
1974	157	51	116	106	324
1975	159	55	129	104	318
1976	163	54	124	109	334
1977	163	54	136	109	334
1978	163	61	140	102	312
1979	166	67	143	99	303

[a] Data supplied by Marion County Appraiser's Office.

[b] Obtained by subtracting number of permanent units from the number of total units.

[c] Based upon an assumed 3.06 persons per seasonal dwelling unit.

d. Trailer Park Residents. There are 56 slots where trailers can be parked on the county park land. These slots are rented from the Lake Superintendent for periods of up to one year. All of the slots are rented each year to at least one tenant and in some cases one slot will be rented more than once a year. For instance, in 1978, the 56 slots were rented a total of 65 times (46).

The major use of the trailer park is on weekends, with more trailers in the park on summer weekends (May to October) than during the fall and winter months (November to April). According to the Lake Superintendent, from May to October there are between 15 and 25 trailers in the park on regular weekends and 25 to 35 trailers in the park on holiday weekends, and from November to April there are from 5 to 10 trailers there each weekend. For the most part, families with children tend to use the trailer park during the summer months whereas during the fall and winter months there are more likely to be retired couples at the park.

Table A-2 presents an estimate of the maximum number of people expected at the lake on the busiest day of the year. This peak day estimate is based upon the assumption that all members of each resident group would be at the lake on a summer holiday weekend. Table A-3 presents the total number of person-days spent at the lake over the entire year by each population group. This number is then divided by 365 to give the number of persons at the lake on an average day.

2. Population Projections

These projections are based on the assumptions that the permanent and seasonal populations will continue to grow at the same rate as they grew from 1969 to 1979; that the lake will remain a viable recreational resource through the year 2000; and, that any sewerage system provided in the LID through a federal grant will have associated with it sufficient land use controls to insure that no additonal development will be induced beyond that which can be expected to occur without the project. The following methods were used to project the future populations of each subgroup at the lake.

TABLE A-2
CURRENT POPULATION ESTIMATE
PEAK DAY

Group	Units	Person per Unit	Population
Holiday Campers	300	3.50	1,050
Seasonal Residents	99	3.06	303
Permanent Residents	67	2.13	143
Seasonal Trailers	35	3.50	123
Peak Day Population			1,619

TABLE A-3
CURRENT POPULATION ESTIMATE
AVERAGE DAY

Group	Units	Persons per Unit	Population	Days/Yr.	Person-Days/Yr.
Holiday Campers	300	3.50	1050	12	12,600
Weekend Campers	100	3.50	350	46	16,100
Seasonal-Summer	59	3.06	181	240	43,440
Seasonal-Weekend	40	3.06	122	48	5,856
Permanent Residents	67	2.13	143	365	52,195
Seasonal Trailers:					
(Summer Wkd.)	20	3.50	70	46	3,220
(Holiday Wkd.)	30	3.50	105	12	1,260
(Winter Wkd.)	10	2.50	25	52	1,300
Total Person-days per Year					135,971

Average Persons per Day 373

a. Permanent and Seasonal Residents. A linear regression model was calibrated on the data for the number of total and permanent dwelling units from 1969 to 1979, and projections were made of total and permanent dwelling units in the years 1985, 1990, 1995 and 2000. The number of seasonal units was obtained by subtracting the projected number of permanent units from the projected number of total units. High correlation coeffcients were obtained for both regression models. Table A-4 presents these projections.

The average persons per permanent household figure from 1969 to 1979 of approximately 2.29 was used to convert the projected number of permanent units to population. While this figure is low by national, state, or county standards, it does accurately reflect the nature of the LID as a predominantly retirement community with a low number of families with children. The average persons per household figure for the Wichita SMSA of approximately 3.06 was used to convert the number of seasonal units to population. As was assumed for the present day population estimates, it was assumed that 40% of the future seasonal residents would stay at the lake for an average of 48 days (2 weekends/month) and that 60% would be continually in residence from April through November, or 240 days.

TABLE A-4

PROJECTED PERMANENT AND SEASONAL POPULATION

	Permanent		Seasonal	
Year	Units	Population	Units	Population
1985	84	194	92	282
1990	100	230	84	257
1995	116	267	77	236
2000	132	302	69	211

b. Trailer Park Residents. Before 1977 there were 70 slots within the trailer park that were available for use. Since 1977 the pattern of slots has been rearranged and now only 56 slots exist. In order to take into account any future rearrangement, it was assumed that 70 slots would be available for use by the year 2000. The peak number of seasonal trailers occupied per day is projected to be 38, based upon a continuation of the current peak period occupancy rate of 62.5 percent.

This technique was used for all the categories of seasonal trailers. It was also assumed that the number of days per year the slots were filled and the number of persons per trailer would remain constant.

c. Campers. Since the large majority of campers at Marion County Lake come from the Wichita area, it was assumed that the future number of campers at the lake would be a function of the population growth of the Wichita SMSA. The Wichita area is expected to grow at the rate of 1.5 percent per year (47), and this growth rate was applied to both the present holiday and weekend figures to produce projections for the year 2000.

d. Total Population. Composite projections for all population subgroups for the peak day in the year 2000 are presented in Table A-5, and projections for the average day are presented in Table A-6. A summary of peak and average day figures for the years 1979 and 2000 are presented in Table A-7. These projections were used as the basis for design of the alternatives developed in this EIS.

TABLE A-5
POPULATION PROJECTION
PEAK DAY - YEAR 2000

Group	Units	Person per Unit	Population
Holiday Campers	405	3.50	1418
Seasonal Residents	69	3.06	211
Permananent Residents	132	2.29	302
Seasonal Trailers	44	3.50	154
Peak Day Population			2085

TABLE A-6
POPULATION PROJECTION
AVERAGE DAY - YEAR 2000

Group	Units	Persons Per Unit	Population	Days/Yr.	Person-Days/Yr.
Holiday Campers	405	3.50	1,418	12	17016
Weekend Campers	135	3.50	473	46	21758
Seasonal-Summer	41	3.06	125	240	30000
Seasonal-Weekend	28	3.06	86	48	4128
Permanent Residents	132	2.29	302	365	110230
Seasonal Trailers:					
(Summer Wkd.)	25	3.50	88	46	4048
(Holiday Wkd.)	38	3.50	133	12	1596
(Winter Wkd.)	13	2.50	33	52	1716
Total Person-days per Year					190492

Average Persons per Day 522

TABLE A-7
POPULATION PROJECTION SUMMARY

Year	Peak Day Population	Average Day Population
1979	1619	373
2000	2085	522

APPENDIX B
HYDROLOGY, GEOLOGY, AND SOILS

1. Climate

Marion County climate is humid continental, with long hot summers and short cold winters.

Rainfall occurs in all months of the growing season. Heaviest rainfall occurs in June, and 73% of the total falls between April and September. Snow cover averages 18 to 20 inches, and is of short duration. It is not unusual for wet and dry years to alternate. The 1930's were dry, and resulted in "dust bowl" conditions. Wide variations in rainfall occur. The normal annual average from 1937 to 1946 was 30.13". The pre-1930 average was 31.31". The 13-year average from 1966 through 1978 is 33.42". Recorded extremes range from 49.31" in 1967 to 22.29" in 1921. The Corps of Engineers used 37.77" for their reservoir studies. A major rainstorm occurred in 1951 when 10.16" of rainfall fell between July 9 and 13.

Temperatures are typical of a mid-latitude continental location. Mean monthly average is 30.5° in January, and 80.0° in July; the mean annual average is 56°. The extremes range from 118° to -32°. Winter cold waves occur, with high winds from the north and below-zero temperatures, while spring and fall are cool and windy. July and August droughts are common. Local hail storms and tornadoes occur. Winds are northerly from December to February, and become strong southerly winds for the rest of the year. Average annual wind speed is 13.7 mph, with 61% being in the 8 to 18 mph range.

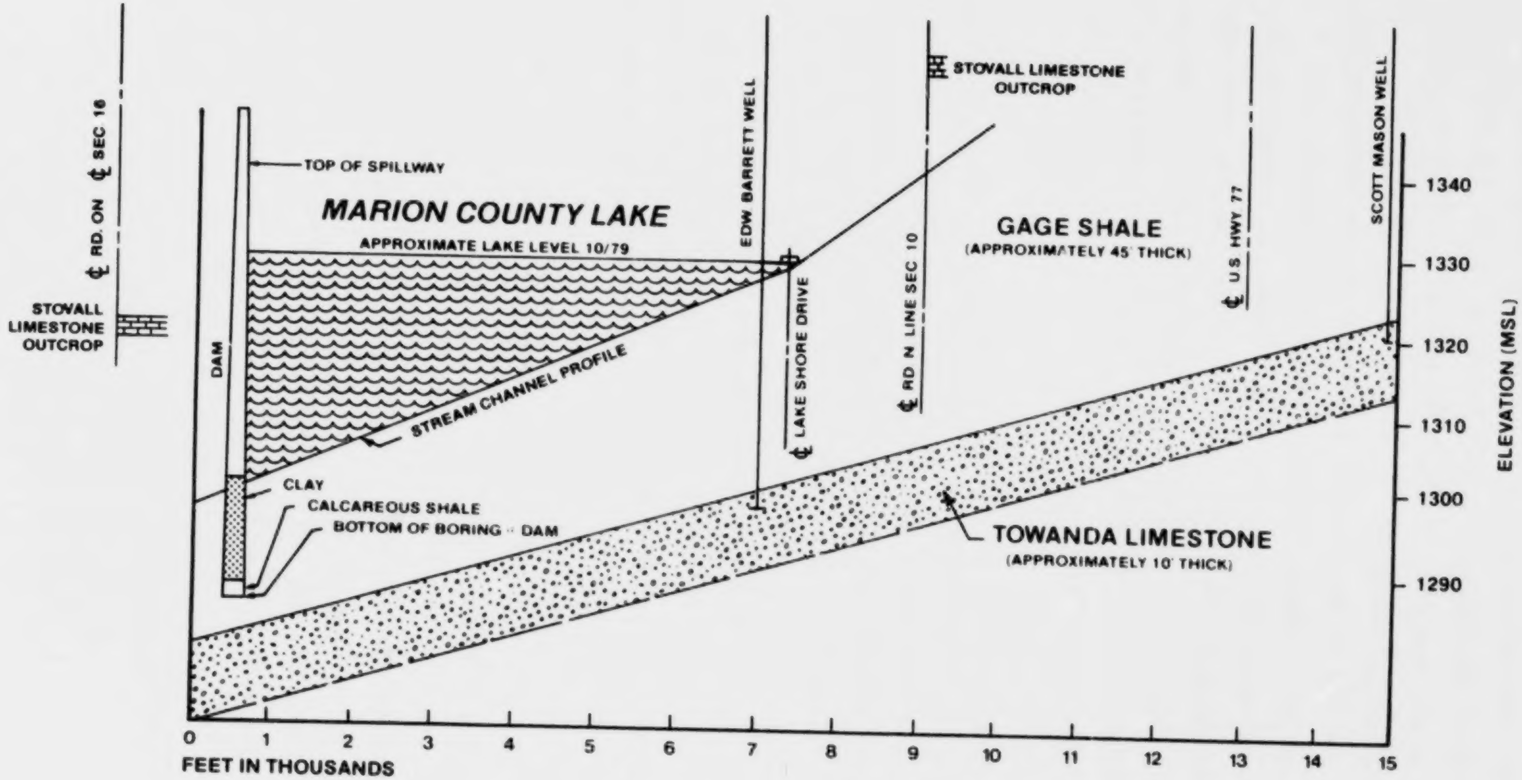
Frost damage to crops is rare. Average dates of first and last killing frosts are October 18 and April 18. Earliest and latest dates of record are September 20 and May 20.

Evaporation rates for a dry year range from a high maximum of 16.21" in July to a low maximum of 2.39" in January. For a normal year the maximum is 10.40" in July and a minimum of 1.92" in January. The average is 6.26" occurring in July.

2. Groundwater Resources

According to the Kansas Geological Survey, no extensive aquifers exist in consolidated sedimentary rock within the study area. The local aquifer is restricted to the interstices near the contact zone between the Gage Shale and the Towanda Limestone formations. The groundwater table prior to 1938, the year in which the Marion County Lake dam was constructed, was in the joints and crevices of the lower portion of the Gage Shale. Four wells drilled before 1938, and ten wells drilled between 1975 and 1978 were all drilled into the top of the Towanda Limestone at depths from 60 to 120 ft. Yields are reported to be on the order of 20 to 30 gpm. The average depth of wells reaching the Towanda Limestone in the lake area is 75-ft. Surface elevations of wells were obtained from USGS quadrangle sheets and are 1350-1370 MSL; therefore, the top of the Towanda Limestone is probably at about 1280-ft MSL at the dam and about 1300-ft MSL at the upper end of the lake.

The Towanda Limestone formation, the local aquifer for wells in the Marion County Lake region, is shown on Figure B-1. Although the Towanda was not identified in outcrop in this study, its stratigraphic position and approximate elevation was determined from a combination of data. The Kansas Geological Survey states that the thickness of the Gage Shale is 45 ft. This shale overlies and separates the Towanda Limestone from the Stovall Limestone above. The Stovall Limestone was located and identified in outcrop at the lake-feeding tributary on the road on the north line of Section 10-T20S-R4E and below the dam on the N-S road through the center of Section 16, as well as locations on the lake shore. Elevations of these two outcrops were obtained from the USGS Topographic map. At the Section 10 outcrop the elevation of the Stovall is taken as 1350 MSL while below the dam it is 1320 MSL. Subtracting 45 ft for the Gage Shale thickness, the top of the Towanda Limestone at these locations would be 1305 and 1275 MSL. The creek channel profile from USGS map elevations is from 1340 MSL at the Section 10 road and 1299 MSL at the dam centerline. This places the top of the Towanda about 20 ft below the base of the dam. The profile



SOURCE OF DATA: OBSERVED OUTCROPS, BORINGS @ DAM, 2 WELL BORING LOGS

SUBSURFACE PROFILE ALONG OLD STREAM CHANNEL IN MARION COUNTY LAKE

Figure B-1
Profile of Local Aquifer

is substantiated by the absence of limestone in the borings for the dam and by the logs of wells at the Scott Mason location in the NW¼ SW¼ Sec. 2 and at the Edward Barrett location in the SW¼ NW¼ Sec. 10. Other wells in the vicinity of the lake and Norman Bower's report (48) show a slightly lesser dip of the Towanda. In any event, all data places the top of the Towanda Limestone ten or more feet below the channel of the tributary creek forming Marion County Lake.

There does not seem to be any connection between surface water and the groundwater aquifer on top of the Towanda Limestone formation, at least above the Marion County Lake dam. The approximate 45-ft thickness of the Gage Shale above the Towanda Limestone acts as a barrier to prevent downward percolation from surface to the aquifer.

3. Surface Water Resources

The surface waters of the study area are limited to the Lake, the creek that feeds the lake, and farm ponds constructed on intermittent tributaries. West of the study area is the Cottonwood River. Mud Creek and Clear Creek join north of Marion and flow through the city to join the Cottonwood. The South Fork and the North Fork of the Cottonwood River join about three miles west of Marion. The North Fork has been dammed by the Corps of Engineers to form Marion Reservoir. The Corps has also constructed a floodway consisting of a levee and a diversion channel to keep Mud Creek from flooding downtown Marion.

The Marion municipal water supply is obtained from Mud Creek. During periods of low water, the supply is augmented from a well, and rationing procedures are invoked. Water for livestock is usually supplied by farm ponds built on intermittent streams. Several such ponds supporting herds of cattle are in the watershed above Marion County Lake, and drain into the lake. Runoff from these areas is a definite source of pollution in the lake.

4. Flooding Potential

The area surrounding the lake within what appears to be the 1330 MSL contour has been classified by HUD as Special Flood Hazard Area Zone A. This is defined as "Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or flood hazard factors determined (49)." This contour is within the lake perimeter road (Lake Shore Drive) and is close to the shoreline at the lower half of the lake. The elevation of the top of the dam is 1346 MSL and the spillway is 1339 MSL.

5. Topography

The study area is in the western portion of the Flint Hills Upland of the Central Lowlands Physiographic Province. The area is underlain by shales, and by limestones with siliceous zones in the form of chert. Topography is governed by weathering of the bedrock, with differential erosion resulting in rolling relief. In this portion of Kansas, the topography is gently rolling, with gentle to moderate slopes punctuated by incised stream valleys and exposures of limestone ledges, especially in the stream valleys and road cuts. Where cherty limestone is near or at the surface, the slopes are generally less than one percent. Steeper slopes border the stream valleys. Topography is nearly level in the valley of the Cottonwood River and its major tributaries.

Marion County is within the Mississippi River Basin drainage area. Regional drainage in this part of Kansas is to the south and southeast via the Cottonwood River flowing into the Neosho and Grand Rivers, joining the Arkansas River in Oklahoma. Marion County Lake was formed by damming an unnamed tributary of the Cottonwood River. The drainage area above the dam is about 6.5 square miles.

Elevations in the lake area range from 1460 feet above mean sea level (MSL) in Sections 25 and 26-T19S-R4E in the northeast part of the drainage area to 1270 feet MSL where the tributary below the dam enters the Cottonwood River in Section 28-T20S-R4E.

6. Geology

Surficial bedrock in the Marion area is comprised of shales and limestones of Permian age. The rocks dip to the west at about 15 feet per mile off the western flank of the Nemaha ridge, a major anticlinal subsurface structure extending north-south across eastern Kansas.

Bedrock formations near the surface or outcropping in the area in descending order of age and with their outstanding characteristic and estimated thicknesses are shown in Figure B-2 and described as follows:

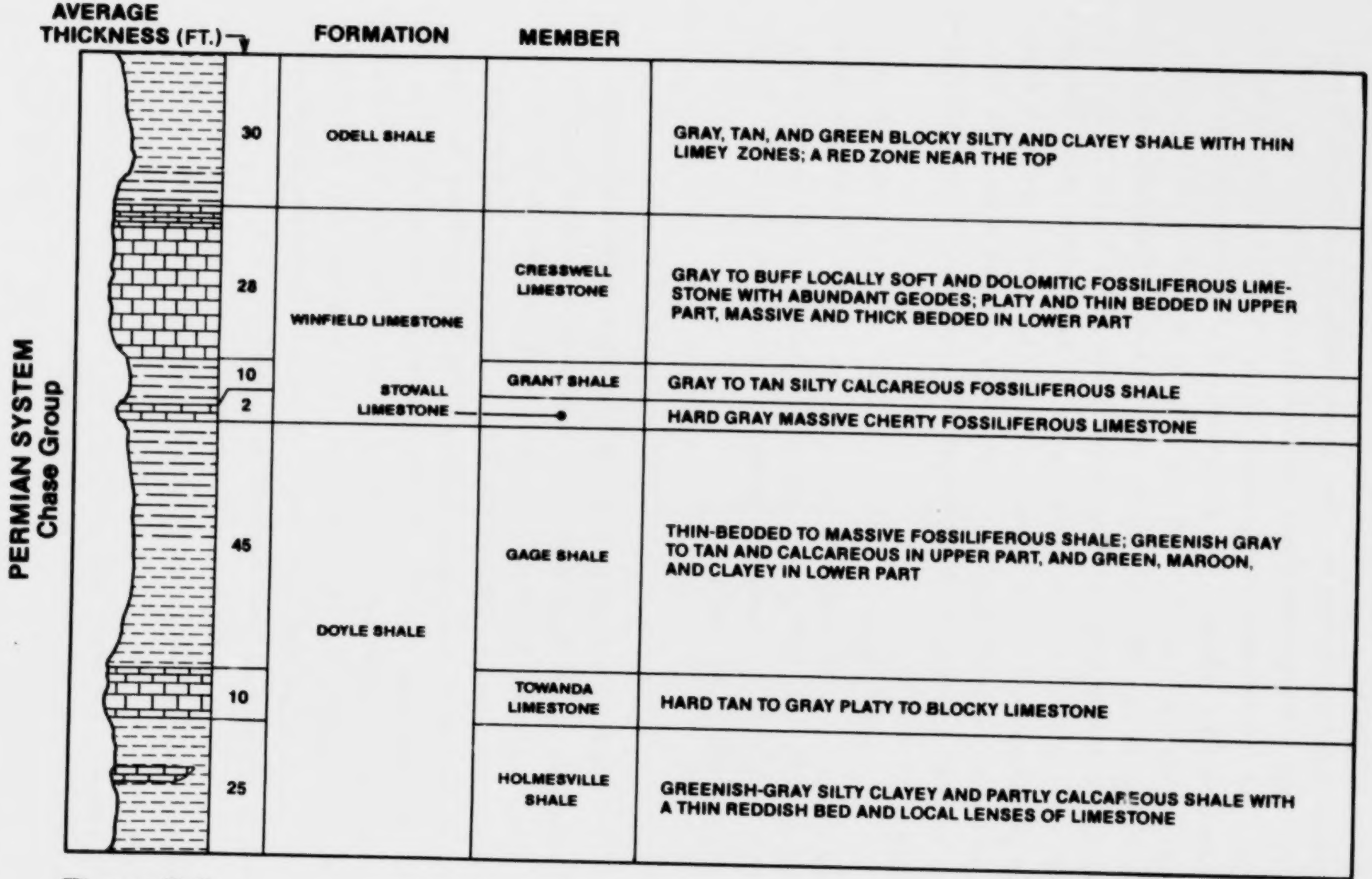
Odell Shale - varicolored - 30 ft thick
Winfield Limestone Group - 40 ft thick
  Cresswell Limestone - concretions and geodes - also locally quarried - 30 ft thick
  Grant Shale - olive to buff - 8 ft thick
  Stovall Limestone - large chert nodules - 2 ft thick

Doyle Shale Group - 80 ft thick
  Gage Shale - varicolored - 45 ft thick
  Towanda Limestone - thin beds, flaggy - 10 ft thick
  Holmesville Shale - thin bedded, calcareous - 25 ft thick

Unconsolidated Quaternary deposits are in the valley downstream of the dam, and consist of slope wash and gravity-type deposits containing silty clays, chert and limestone gravel (Sanborn formation) and silty terrace deposits.

7. Mineral Resources

Mineral production in Marion County was valued at $3,338,000 in 1974. Petroleum, stone and natural gas in order of value are the principal mineral resources. Most of the oil production is from the Lost Springs field which begins about 4 miles north of Marion and



PERMIAN SYSTEM Chase Group AVERAGE THICKNESS (FT.)	FORMATION	MEMBER	
30	ODELL SHALE		GRAY, TAN, AND GREEN BLOCKY SILTY AND CLAYEY SHALE WITH THIN LIMEY ZONES; A RED ZONE NEAR THE TOP
28	WINFIELD LIMESTONE	CRESSWELL LIMESTONE	GRAY TO BUFF LOCALLY SOFT AND DOLOMITIC FOSSILIFEROUS LIMESTONE WITH ABUNDANT GEODES; PLATY AND THIN BEDDED IN UPPER PART, MASSIVE AND THICK BEDDED IN LOWER PART
10		GRANT SHALE	GRAY TO TAN SILTY CALCAREOUS FOSSILIFEROUS SHALE
2		STOVALL LIMESTONE	HARD GRAY MASSIVE CHERTY FOSSILIFEROUS LIMESTONE
45	DOYLE SHALE	GAGE SHALE	THIN-BEDDED TO MASSIVE FOSSILIFEROUS SHALE; GREENISH GRAY TO TAN AND CALCAREOUS IN UPPER PART, AND GREEN, MAROON, AND CLAYEY IN LOWER PART
10		TOWANDA LIMESTONE	HARD TAN TO GRAY PLATY TO BLOCKY LIMESTONE
25		HOLMESVILLE SHALE	GREENISH-GRAY SILTY CLAYEY AND PARTLY CALCAREOUS SHALE WITH A THIN REDDISH BED AND LOCAL LENSES OF LIMESTONE

Figure B-2

Generalized Geologic Column

SOURCE: USGS BULLETIN 1060

continues north to Herington. This is the nearest production to the project area. The Stenzel field, about 3 miles west southwest of Marion, and the Robinson field, about 8 miles east southeast of Marion, are abandoned gas fields. The latest available production figures for Marion County are from 1977 and show 373,766 barrels of oil produced from 559 wells and 956,000 M cu ft of gas produced from 78 wells. The Peabody and Florence oil fields, located near these cities to the south and southeast of the project area, declined about 1930, having been producing since 1918. Some of the stripper wells are producing by secondary recovery methods. It has been reported that there is some current drilling activity around Florence, about 5 miles southeast of the project area.

Crushed stone is produced by the Hallett Construction Co., with quarries in the southeast quarter of Section 4 and the northeast quarter of Section 6-T21S-R4E, and by the Sunflower Crushed Stone Co., with a quarry in the southeast quarter of Section 6-T21S-R5E. No production figures are available.

8. Soils

Soil suitability is one of the major factors affecting alternatives to existing wastewater treatment and sewage disposal systems. Information on soil suitability is provided by the Soil Conservation Service (SCS) of the U.S. Department of Agriculture, through published county soil surveys. The Marion County Soil Survey was last published in 1930. An updated county soil survey is in process and is scheduled for completion about 1981, but limited soils data is available for the study area. SCS provides soil suitability data including permeability, depth to bedrock, drainage, slopes, depth to high groundwater, and engineering properties.

Soils in the Marion County Lake area are mostly silty clays developed by weathering and erosion of the underlying limestone and shale deposits. Soil cover is generally thin, especially over the limestones. The major soil associations found in the study area are shown on Figure B-3 and are described below.

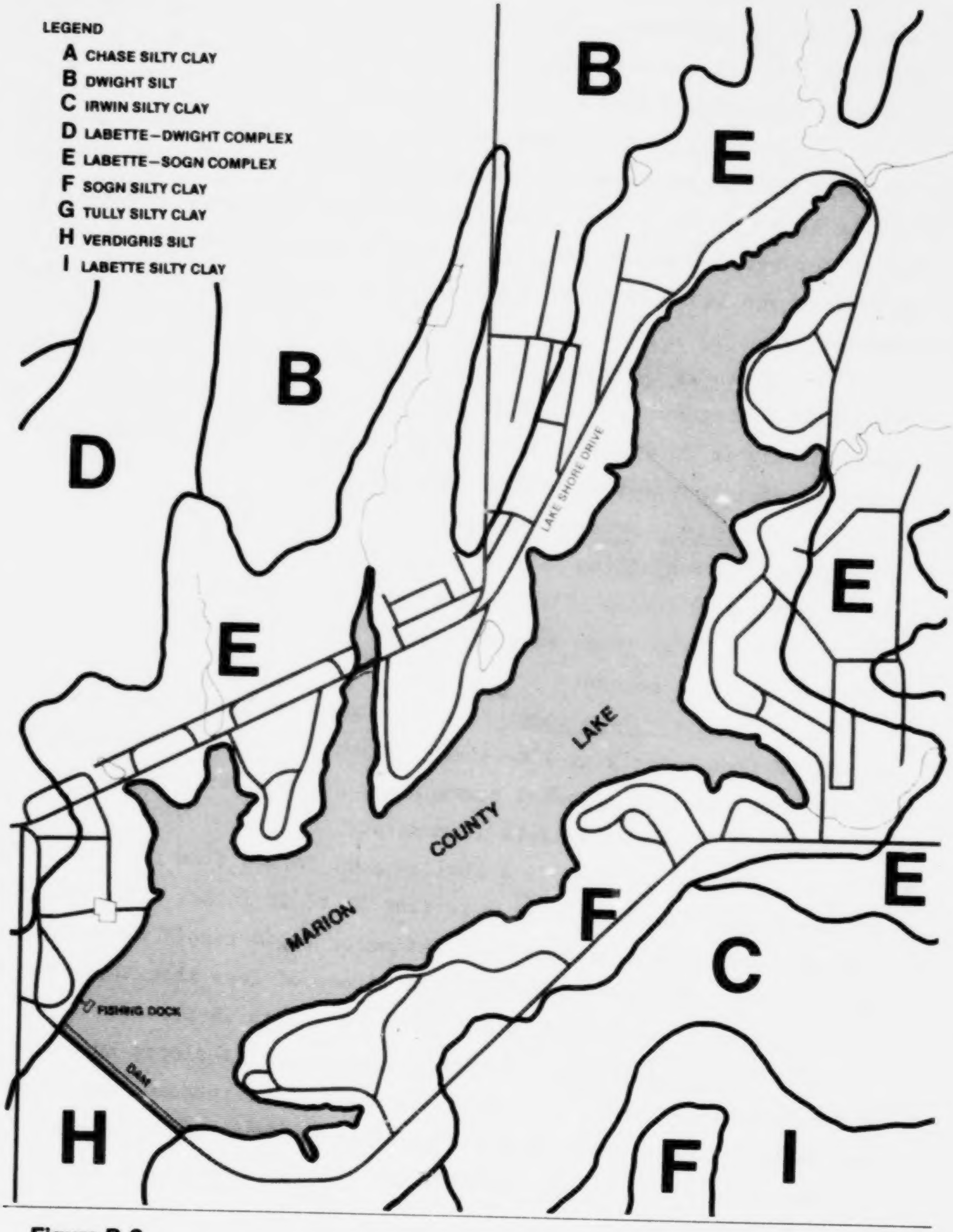


Figure B-3
Soil Associations

Chase silty clay is formed in clayey alluvium on low terraces of larger streams. This soil is moderately well to poorly drained, and is slowly permeable. It is subject to occasional brief flooding. Depth to rock is greater than 5-ft, and depth to perched high water table is from 1 to 3 feet.

Dwight silt is formed from clay shales with possible mixture of loess and old alluvium. It is moderately well drained and permeability is very slow. Occasional small depressional areas may pond water for several days. The soil is fine textured over hard cherty limestone and is found on upland divides with slopes of less than four percent.

Irwin silty clay is formed from clay shales or old alluvium over hard limestone. The soil is moderately to well drained and permeability is very slow. It is found on uplands with slopes up to eight percent, but averaging less than three percent.

Labette - Dwight complex is a silt to silty clay soil formed from limestone containing thin beds of clay shale. Depth to bedrock is from 20 to 40 inches. The soil is well drained and permeability is slow. This soil is found on nearly level uplands, with slopes ranging from one to eight percent.

Labette - Sogn complex is a silty clay formed from residuum weathered from underlying limestone. Depth to bedrock is less than 40 inches. The soil is somewhat excessively drained, with medium or rapid runoff, and permeability is moderate.

Sogn silty clay is a shallow soil formed from the weathering of limestone. Depth to bedrock is from 10 to 20 inches. The soil is somewhat excessively drained with medium or rapid runoff and permeability is moderate. It is normally found on slopes of less than three percent, but ranges up to moderately steep slopes of up to 15 percent.

Tully silty clay is formed at the toes of slopes in areas where soils have been formed in residuum from interbedded limestone and shale. Slopes range from two to seven percent, and range up to 15 percent. The soil is well drained, and runoff is medium to rapid. Permeability is slow.

Verdigris silt is deep, well to moderately drained soil formed in silty alluvium, and is found in the flood plains. Depth to bedrock exceeds five feet. Slope gradient is commonly less than one percent, ranging up to two percent. Runoff is slow to medium and permeability is moderate. This soil is occasionally flooded.

Labette silty clay is formed on nearly level to sloping uplands weathered from underlying limestone and interbedded clayey shales. Slopes range from one to eight percent. Depth to bedrock is about 36 inches. The soil is well drained with medium to rapid runoff and permeability is slow becoming very slow with depth.

Limitations for septic tank leach fields and sewage lagoons for various soils are rated as having slight, moderate, or severe limitations. "Soils with slight limitations are good for seepage fields, and only minimal expenditures are required for safe effluent disposal without environmental hazards. Soils with moderate limitations have some undesirable properties; careful planning and design of seepage fields are needed in these areas to compensate for the limitations imposed by the soils. Soils with severe limitations have problems for seepage fields that are difficult to overcome: slow permeability, shallowness to bedrock, wetness, flooding, slope, stoniness, or some other unfavorable soil property." The criteria for these limitation classifications are shown in Table B-1.

The limitations for sewage purposes of the area soils are shown on Table B-2.

The prime farmland inventory indicates that all soils in the area except Dwight and Sogn are designated as prime or unique agricultural land.

9. Geologic Constraints on Sewerage Alternatives

a. Excavation. Excavation will encounter firm rock at depths of less than five feet over most of the study area. Excepted areas are in Irwin, Tully, Chase and Verdigris soils. Irwin soils are on the uplands near the drainage divides and are underlain by shale. Tully soils are limited in area, and are found below the dam. Chase

TABLE B-1
SOIL LIMITATIONS CRITERIA

Septic Tank Seepage Field Rating

	Slight	Moderate	Severe
Percolation Rate	faster than 45 min/in	45-60 min/in	slower than 60 min/in
Depth to Water Table	over 72"	40" - 72"	under 48"
Flooding	none	rare	occasional or frequent
Slope	0-8%	8-15%	over 15%
Depth to bedrock	over 72"	48"-72"	under 48"

Sewage Lagoon Rating

	Slight	Moderate	Severe
Permeability	Under 0.6 in/hr	0.6-2.0 in/hr	over 2.0 in/hr
Depth to Water Table	under 60"	40"-60"	under 40"[1]
Flooding	none	none	subject to flood [2]
Slope	under 2%	2-7%	over 7%
Depth to bedrock	over 60"	40"-60"	under 40"
Unified classification	GC,SC,CL,CH	GM,ML,SM,MH	GP,GW,SW,SP,OL,OH,PE

1. Disregard depth to water if floor is 2-ft thickness of impervious material.

2. Disregard flooding if floodwater has low velocity, depth under 5-ft, and is not likely to enter or damage lagoon embankment.

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TABLE B-2

SOIL LIMITATIONS FOR SEWAGE DISPOSAL

Soil Series	Septic Tank	Lagoon
Chase	Severe, slow permeability	Moderate, some flooding
Dwight	Severe, slow permeability	Moderate, bedrock 40"-60"
Irwin	Severe, slow permeability	Slight, slopes under 2% Moderate, slopes 2-7% Severe, slopes over 7%
Labette-Dwight	Severe, slow permeability, bedrock 20"-40"	Severe, bedrock 20"-40"
Labette-Sogn	Severe, slow permeability bedrock 20"-40"	Severe, bedrock 20"-40"
Sogn	Severe, bedrock 10"-20"	Severe, bedrock 10"-20"
Tully	Severe, slow permeability	Slight, slopes under 2% Moderate, slopes 2-7% Severe, slopes over 7%
Verdigris	Moderate to severe, occasional flooding	Severe, frequent flooding

and Verdigris soils are in the tributary creek valley below the dam, and are subject to flooding by backwater from the Cottonwood River.

b. Lagoon Construction. None of the soils in the study area are conducive to lagoon construction. Most are less than five feet thick above bedrock, and have low strength and high shrink-swell characteristics. Verdigris soils are subject to flooding and to piping, a subsurface erosive phenomenon. Chase soils are difficult to compact. Dwight and Verdigris soils are easily eroded, as are the other soils to a somewhat lesser degree. Embankment erosion protection is required for all soils of the area. Grasses are not satisfactory for protection from wave action. Most of the soils percolate slowly to very slowly and are, therefore, suitable for water containment.

c. Surface Discharge. Any surface discharge within the drainage basin above the dam will eventually enter the lake. The silty clay soils intensify runoff and the subsurface shales are relatively impervious so that any downward seepage which may intersect the shale beds will be directed down the stratigraphic dip to the west. The areas on the west side of the creek valley and the area below the dam will not discharge into the lake. The Towanda Limestone, the local aquifer, is separated from the lake bed by more than 10 ft of impervious shale and lake sediments, and is not likely to be contaminated by lake pollutants, should they exist.

d. Land Application. Soils in the study area, except Dwight and Sogn, are suitable for agricultural irrigation using treated wastewater. This type of irrigation has not been practiced in the area except for watering the Marion golf course and the grounds around the airport. Not many crops are planted outside of the floodplain areas. Rangeland grass is the major ground cover in the project area, and is used extensively for cattle grazing.

e. Treatment Plant Sites. The two proposed plant location sites near the Cottonwood River in the SE corner of Section 5 and the SW corner of Section 9, as shown in the Facility Plan, are in Irwin soils. The ratings for sewage lagoons in this soil depend upon the slope of the land, ranging from slight for 0-2% slopes to severe for slopes exceeding 7%. Maximum slope at these locations is about 4% so the rating is slight to moderate. The well drained soils are about 6 ft thick over hard limestone. Both sites are satisfactory from a soils standpoint. The proposed alternative site of the regional plant is in the SW¼. Sec. 4-T20S-R4E, where most of the soils are Dwight. They occur on the upland divides and are moderately well drained. Permeability is very slow. This site is on the west side of the airport property, and any discharge would enter a tributary of the Cottonwood River to the south and west of the Lake. The soil material is rated by SCS as having low strength for foundations, but hard limestone is less than 5-ft below the surface. The location is convenient for both the City of Marion and the lake area. Pipe lines would encounter rock excavation over much of the force main route.

An alternative site investigated by the EIS is below the dam, in Verdigris soils and the flood plain of the tributary. The dam has noticeable seepage, and road cracks on the crest of the dam indicate some weakness. Verdigris soils are well drained, with slow to medium runoff and moderate permeability. The soil has low strength for construction, and is subject to piping, a subsurface erosion phemonenon. The location in the flood plain is also subject to flooding by backwater from the Cottonwood River. The area is presently under irrigated cultivation. The location is convenient but not desirable for the above reasons.

f. Cluster Tanks & Community Leach Fields. All soils in the project area are rated as severe for septic tank systems except the Verdigris, which is below the dam. Because of this rating, some other means of treatment should be used, although it appears that most of the septic tank systems are working at the present time. The installation of holding tanks usually involves rock excavation because rock is near the surface in the study area. Cluster tanks with grouped or common leach fields may be a viable alternative. In order to construct these, it probably will be necessary to use a mound type, whereby the leach field is constructed on or above existing ground and suitable soil encloses the tile laterals within the leach field.

APPENDIX C

FLORA AND FAUNA

The following vegetation was observed in the project area:

TREES

Common Name	Scientific Name
Boxelder	Accer negundo
Hackberry	Celtis occidentalis
Redbud	Cercis canadensis
Green Ash	Fraxinus pennsylvanica
Honey Locust	Glenditsia triacanthos
Black Walnut	Juglaus nigra
Red Cedar	Juniperus virginiana
Osage Orange	Maclura pomifera
Red Mulberry	Morus rubra
Eastern Cottonwood	Populus detoides
Bur Oak	Quercus macrocarpa
Black Willow	Salix nigra
American Elm	Ulmus americana
Red Elm	Ulmus rubra

SHRUBS AND WOODY VINES

False Indigo	Amorpha fruticosa
Smooth Sumac	Rhus glabra
Poison Ivy	Rhus radicans
Wild Gooseberry	Ribes missouriensis
Prairie Rose	Rosa suffulta
Black Raspberry	Rubus occidentalis
Greenbriar	Similax hispida
Coralberry	Symphoricarpos orbiculatus
Wild Grape	Vitis sp.

HERBS

Common Name	Scientific Name
Pigweed	*Amaranthus retroflexus*
Ragweed	*Ambrosia* sp.
Big Bluestem	*Andropogon gerardi*
Little Bluestem	*Andropogon scoparium*
Three-awn Grass	*Artistida oligantha*
Drummond Aster	*Aster drummondi*
Tall White Aster	*Aster simplex*
Stick Tight	*Bidens* sp.
Sideoates Grama	*Bouteloua curtipendula*
Purple Thistle	*Cirsium altissimum*
Horseweed	*Cenyza canadensis*
Queen Anne's Lace	*Daucus carota*
Spike Rush	*Eleocharis* sp.
Wild Rye	*Elymus canadensis*
White Snakeroot	*Eupatorium rugosum*
Snow-on-the-Mountain	*Euphorbia marginata*
Sunflower	*Helianthus* sp.
Jerusalem Artichoke	*Helianthus tuberosa*
Ground Cherry	*Physalis heterophylla*
Pokeberry	*Phytolacca americana*
Smartweed	*Polygonum* sp.
Pale Dock	*Rumex altissimus*
Mad-dog Skullcap	*Scutellaria laterifolia*
Nettle	*Solanum* sp.
Goldenrod	*Solidago* sp.
Indian Grass	*Sorghastrum nutans*
Tall Stinging Nettle	*Urtica procera*
Ironweed	*Veronia baldwinil*
Cockle Bur	*Xanthum speciosum*

Common Name	Scientific Name
Curlycup Gumweed	*Grindelia squarrosa*
Blazing Star	*Liatris punctata*
Prairie Coneflower	*Ratibida columnaris*
Wild Alfalfa	*Psoralea tenuiflora*
Purple Prairie Clover	*Petalostemon purpureus*
Blue Wild Indigo	*Baptisia australis*

SHORELINE AND AQUATIC PLANTS

Coontail	*Ceratophyllum demersum*
Leafy Pondweed	*Potamogeton foliosus*
Largeleaf Pondweed	*Potamogeton amplifolius*
Longleaf Pondweed	*Potamogeton nodosus*
Sedges	*Carex* sp.
Cat-tail	*Typha latifolia*
Filamentous Green Algae	*Spirogyra* sp.
Southern Naiad	*Najas guadalupensis*

FAUNA KNOWN TO INHABIT THE MARION COUNTY LAKE AREA

FISH

Black Crappie	*Pomoxis nigromaculatus*
White Crappie	*Pomoxis annularis*
Gizzard Shad	*Dorosoma cepedianum*
Bluegill	*Lepomis macrochirus*
Channel Catfish	*Ictalurus punctatus*
Longeared Sunfish	*Lepomis megalotis*
Freshwater Drum	*Aplodinotus grunnieus*
Northern Pike	*Esox lucius*

Common Name	Scientific Name
Mississippi Silversides	Menidia audeus
Spotted Bass	Micropterus punctulatus
Largemouth Bass	Micropterus salmoides
Grass Carp	Ctenopharyngodon idella
Carp	Cyprinus carpio
Black Bullhead	Ictalurus melas
Warmouth Sunfish	Lepomis gulosus
Golden Shiner	Notemigonus crysoleucas
Walleye	Stizostedion vitreum
Green Sunfish	Lepomis cyanellus
Red Shiner	Notropis lutrensis
Bluntnose Minnow	Pimephales notatus

AMPHIBIANS

Tiger Salamander	Ambystoma tigrinum
Plains Spadefoot Toad	Scaphyiopus bombifrons
Great Plains Toad	Bufo cognatus
Woodhouse's Toad	Bufo woodhousei
Northern Cricket Frog	Acris crepitans
Spotted Chorus Frog	Psuedacris clarki
Striped Chorus Frog	Psuedacris nigrita
Bullfrog	Rana catesbeianna
Leopard Frog	Rana pipieus
Western Narrow-mouthed Frog	Gastrophryrne olivacea

REPTILES

TURTLES

Common Musk Turtle	Stenotherus odoratus
Yellow Mud Turtle	Kinosternon flavescens
Common Snapping Turtle	Chelydra serpentina

Common Name	Scientific Name
Ornate Box Turtle	*Terrapene ornata*
Painted Turtle	*Chrysemys picta*
Red-eared Turtle	*Psuedemys scripta*
Smooth Softshell Turtle	*Trionyx mutica*
Spiny Softshell Turtle	*Trionyx spinifera*

LIZARDS

Earless Lizard	*Holbrookia maculata*
Collared Lizard	*Crotophytus collaris*
Fence Lizard	*Sceloporus undulatus*
Horned Lizard	*Phrynosoma cornutum*
Common Five-lined Skink	*Eumeces fasciatus*
Sonoran Skink	*Eumeces obsoletus*
Six-lined Racerunner	*Cnemidophorus sexlineatus*
Slender Glass Lizard	*Ophisaurus attenuatus*

SNAKES

Eastern Ringneck Snake	*Diadophis punctatus*
Eastern Hognose Snake	*Heterodon platyrhynos*
Western Hognose Snake	*Heterodon nasicus*
Blue Racer	*Coluber constrictor*
Coachwhip Snake	*Masticophis flagellum*
Black Rat Snake	*Elaphe obsoleta*
Bullsnake	*Pituophis melanoleucus*
Prairie Kingsnake	*Lampropeltis calligaster*
Speckled Kingsnake	*Lampropeltis getulus*
Red Kingsnake	*Lampropeltis doliata*
Plains Ground Snake	*Sonora episcopa*
Flat-headed Snake	*Tantilla gracilis*
Plains Black-headed Snake	*Tantilla nigriceps*
Yellow-bellied Water Snake	*Natrix erythrogaster*
Graham's Water Snake	*Natrix grahami*

Common Name	Scientific Name
Diamondback Water Snake	*Natrix rhombifera*
Northern Water Snake	*Natrix sipedon*
Northern Brown Snake	*Storeria dekayi*
Plains Garter Snake	*Thamnophis radix*
Red-sided Garter Snake	*Thamnophis sirtalis*
Western Ribbon Snake	*Thamnophis proximus*
Lined Snake	*Tropidoclonium lineatum*
Western Massasauga	*Sistrurus catenatus*
Prairie Rattle Snake	*Crotalis viridis*

BIRDS (Residents)

Pied-billed Grebe	*Podilymbus padiceps*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Pintail Duck	*Anas acuta*
Turkey Vulture	*Cathates aura*
Red-tailed Hawk	*Buteo jamaicensis*
Sparrow Hawk	*Falco sparverius*
Bobwhite Quail	*Colinus cupido*
Rio Grande Turkey*	*Meleagris gallopavo*
Greater Prairie Chicken	*Tympanuchus cupido*
Mourning Dove	*Zenaidura macroura*
Killdeer	*Charadrus vociferus*
Woodcock	*Philohela minor*
Upland Plover	*Bartramia longicauda*
Western Meadowlark	*Sturnella neglecta*
Yellow-billed Cuckoo	*Coccyzus americanus*
Dickcissel	*Spiza americana*
Barn Owl	*Tyto alba*
Screech Owl	*Otus asio*
Great Horned Owl	*Bubo virginianus*
Common Night Hawk	*Chordeiles minor*

Common Name	Scientific Name
Red Headed Woodpecker	Melanerpes erythrocephalus
Hairy Woodpecker	Dendrocopos villosus
Eastern Kingbird	Tyrannus tyrannus
Barn Swallow	Hirundo rustica
Blue Jay	Cyanocitta crista
Common Crow	Corvus brachyrhynchus
Black-capped Chickadee	Parus atricapillus
Tufted Titmouse	Parus bicolor
Common Catbird	Dumetella carolinensis
Robin	Tundus migratorius
Cardinal	Richmondena cardinalis
Mockingbird	Mimus polyglottos
Grasshopper Sparrow	Ammodramus savannarium
Field Sparrow	Spizella pusilla

*recent introduction

MAMMALS

Virginia Oppossum	Didelphis virginianus
Short-tailed Shrew	Blarina brevicauda
Least Shrew	Cryptotis parva
Eastern Mole	Scalopus aquaticus
Little Brown Myotis	Myotis lucifugus
Big Brown Bat	Eptesicus fuscus
Hoary Bat	Lasiurus cinereus
Black-tailed Jackrabbit	Lepus californicus
Cottontail Rabbit	Sylvilagus floridanus
Fox Squirrel	Sciurus niger
Thirteen-lined Ground Squirrel	Cynomys ludovicianus
Franklin's Ground Squirrel	Citellus franklinii
Pocket Gopher	Geomys busarius
Hispid Pocket Mouse	Perognathus hispidus

Common Name	Scientific Name
Beaver	Castor canadensis
Grasshopper Mouse	Onychomys leucogaster
Pigmy Harvest Mouse	Reithroclontomys montanus
Deer Mouse	Peromyscus maniculatus
Wood Mouse	Peromyscus leucopus
Hispid Cotton Rat	Sigmodon hispidus
Florida Wood Rat	Neotoma floridanus
Lemming Mouse	Synaptomys cooperi
Prairie Vole	Microtus ochrogaster
Coyote	Canis latrans
Red Fox	Vulpes fulva
Striped Skunk	Mephitis mephitis
Spotted Skunk	Spilogal interuptus
White-tailed Deer	Odocoileus virginianus
Raccoon	Procyon lotor
Bobcat	Lynx rufus
Muskrat	Ondatra zibethica
Antelope*	Antilocapra americana
Woodchuck	Marmota monax
Longtail Weasel	Mustela frenata

*recent introduction

APPENDIX D
SEPTIC LEACHATE SURVEY REPORT

SEPTIC LEACHATE SURVEY

MARION COUNTY LAKE, KANSAS

November, 1979

Prepared for

U.S. Environmental Protection Agency
324 East 11th Street
Kansas City, Missouri 64106

Prepared by

K-V Associates, Inc.
Falmouth, Massachusetts

December, 1979

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D.1

1.0 INTRODUCTION

Marion County Lake, the study area, is located in the eastern portion of the Flint Hills, northeast of Wichita, Kansas. This lake was formed by damming an unnamed tributary of the Cottonwood River. The dam was constructed in the 1930's by the Civilian Conservation Corps and provides for a lake surface of about 150 acres. The area is underlain by shales and limestone formations. The lake was built for fishing and recreational purposes and is now settled by approximately 230 year-round or seasonal dwellings along Lake Shore Drive, which encompasses the northern two-thirds of the lake. All homes are serviced by individual water wells and septic tanks. This lake area is currently undergoing a sewering needs evaluation designed to determine the extent of septic waste water impacts on the lake. The following report presents the results of a septic leachate survey of Marion County Lake performed during November, 1979

1.1 Effluent Plume Theory

In porous soils, groundwater inflows frequently convey wastewaters from nearshore septic units through bottom sediments and into lake waters, causing attached algae growth and algal blooms. The lake shoreline is a particularly sensitive area since: 1) the groundwater depth is shallow, encouraging soil water saturation and anaerobic conditions; 2) septic units and leaching fields are frequently located close to the water's edge, allowing only a short distance for bacterial degradation and soil adsorption of potential contaminants; and 3) the recreational attractiveness of the lakeshore often induces temporary overcrowding of homes leading to hydraulically overloaded septic units. Rather than a passive release from lakeshore bottoms, groundwater plumes from nearby on-site treatment units may actively emerge along shorelines raising sediment nutrient levels and creating local elevated concentrations of nutrients. The contribution of nutrients from subsurface discharges of shoreline septic units has been estimated at 30 to 60 percent of the total nutrient load in certain New Hampshire lakes (LRPC, 1977).

The capillary-like structure of sandy, porous soils and horizontal groundwater movement induces a fairly narrow plume from malfunctioning septic units. The point of discharge along the shoreline is often through a small area of lake bottom, commonly forming an oval-shaped area several meters wide when the septic unit is close to the shoreline. In denser subdivisions containing several overloaded units, the discharges may overlap forming a broader increase (see Figure 1).

1.1.1 Groundwater Plumes

Three different types of groundwater-related wastewater plumes are commonly encountered during a septic leachate survey: 1) erupting plumes, 2) passive plumes, and 3) stream source plumes. As the soil becomes saturated with dissolved solids and organics during the aging process of a leaching on-lot septic system, a breakthrough of organics occurs first, followed by inorganic penetration (principally chlorides, sodium, and other salts). The active emerging of the combined organic

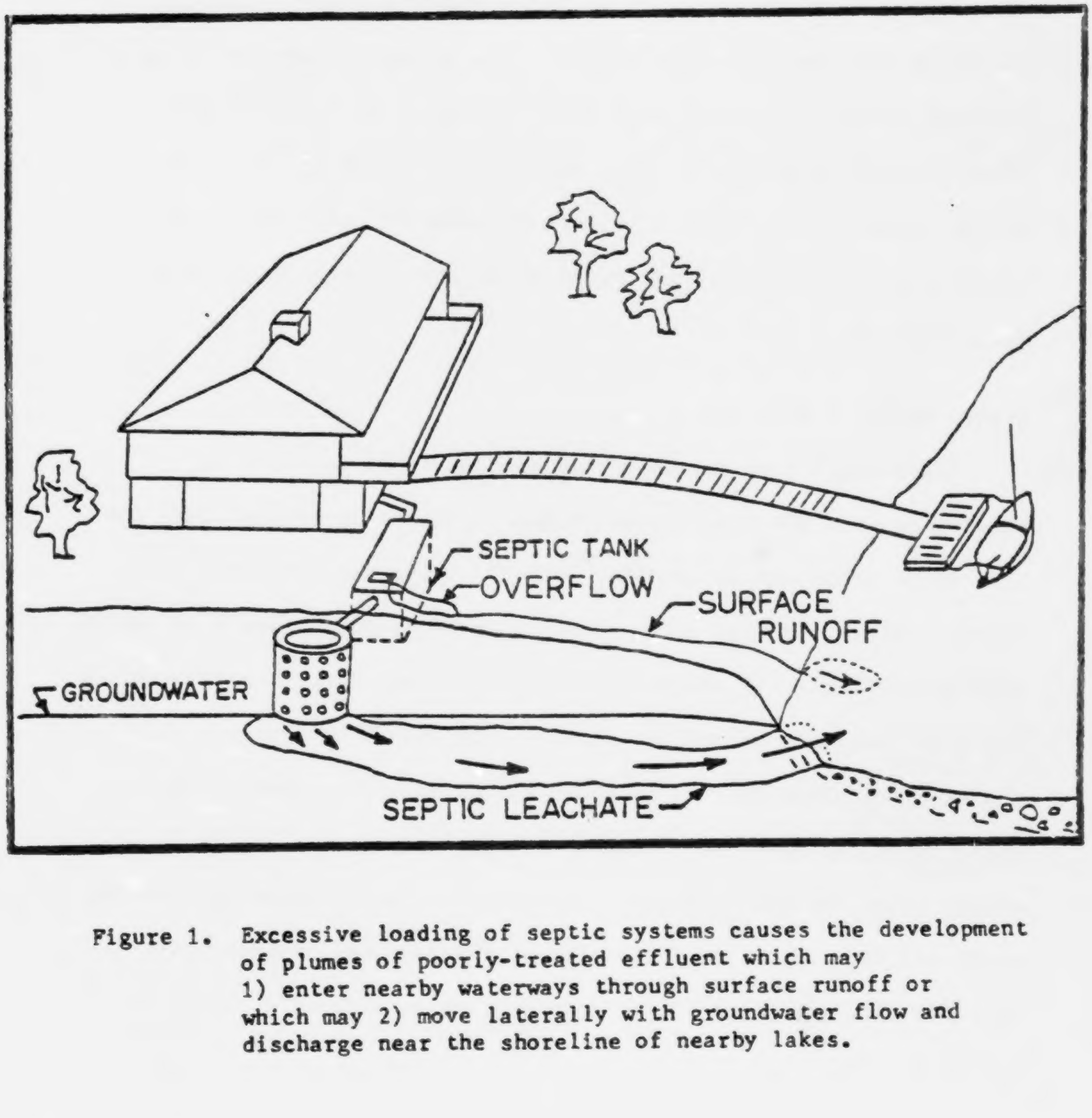

Figure 1. Excessive loading of septic systems causes the development of plumes of poorly-treated effluent which may 1) enter nearby waterways through surface runoff or which may 2) move laterally with groundwater flow and discharge near the shoreline of nearby lakes.

and inorganic residues into the shoreline lake water describes an erupting plume. In seasonal dwellings where wastewater loads vary in time, a plume may be apparent during late summer when shoreline cottages sustain heavy use, but retreat during winter during low flow conditions. Residual organics from the wastewater often still remain attached to soil particles in the vicinity of the previous erupting plume, slowly releasing into the shoreline waters. This dormant plume indicates a previous breakthrough, but sufficient treatment of the plume exists under current conditions so that no inorganic discharge is apparent. Stream source plumes refer to either groundwater leachings or near-stream septic leaching fields which enter into streams which then empty into the lake.

1.1.2 Runoff Plumes

Traditional failures of septic systems occur in tight soil conditions when the rate of inflow into the unit is greater than the soil percolation can accomodate. Often leakage occurs around the septic tank or leaching unit covers, creating standing pools of poorly-treated effluent. If sufficient drainage is present, the effluent may flow laterally across the surface into nearby waterways. In addition, rainfall or snow melt may also create an excess of surface water which can wash the standing effluent into water courses. In either case, the poorly-treated effluent frequently contains elevated fecal coliform bacteria, indicative of the presence of pathogenic bacteria and, if sufficiently high, must be considered a threat to public health.

1.2 Special Survey Technique and Equipment

Wastewater effluent contains a mixture of near-UV fluorescent organics derived from whiteners, surfactants and natural degradation products which are persistent under the combined conditions of low oxygen and limited microbial activity. Figure 2 shows two samples of sand filtered effluent from the Otis Air Force Base, Massachusetts, sewage treatment plant. One was analyzed immediately and the other after having been held in a darkened bottle for six months at 20°C. Note that little change in fluorescence was apparent, although during the aging process some narrowing of the fluorescence region did occur. The aged effluent percolating through sandy loam soil under anaerobic conditions reaches a stable ratio between the organic content and chlorides which are highly mobile anions. It is this stable ratio (cojoint signal) between fluorescence and conductivity that allows ready detection of leachate plumes by their conservative tracers. Such identified plumes are an early warning of potential nutrient breakthrough or public health problems. The septic leachate detector instrument utilizes this principal.

Septic surveys for shoreline wastewater discharges are conducted with a septic leachate detector, ENDECO Type 2100 "Septic Snooper"™, and the K-V Associates, Inc. "Dowser"™ Groundwater Flowmeter. The leachate detector unit can be operated out of any small rowboat. It consists of the subsurface probe (water intake system), the analyzer control unit, and an analog stripchart recorder. Initially the unit is calibrated against incremental additions of wastewater effluent of the type to be detected to the background lake water. The pump end of the

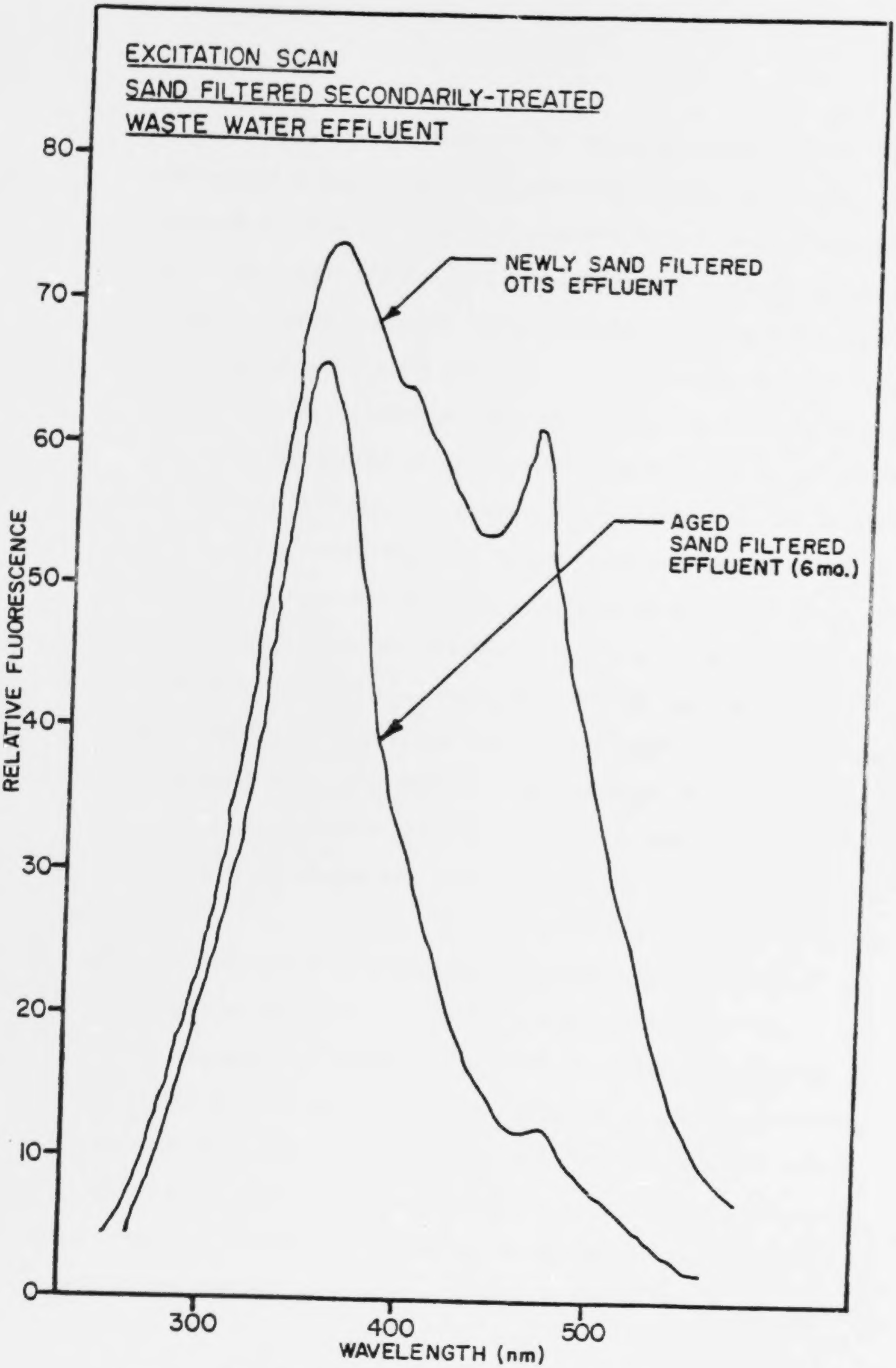

Figure 2. Sand-filtered effluent produces a stable fluorescent signature, here shown before and after aging.

probe unit is then submerged in the lake water along the near shoreline. Groundwater seeping through the shoreline bottom is drawn into the screened intake of the probe and travels upwards to the analyzer unit. As it passes through the analyzer, separate conductivity and fluorescence signals are generated. The responses are sent to a signal processor which registers the separate signals on a strip chart recorder as the boat moves forward. The analyzed water is continuously discharged from the unit back into the receiving water. The battery powered unit used for field studies can record individual fluorescence and conductivity or a combination signal. It has also been modified to operate under the conductance conditions encountered in the field.

Well-point sampling of groundwater and bacterial sampling of surface run-off complement the leachate detector scan, surface water sampling and groundwater flow vector measurements for the complete survey.

2.0 METHODOLOGY - SAMPLING AND ANALYSIS

The objectives of this survey were:

1) To perform a shoreline scan of the northeast and western shore for evidence of septic leachate intrusion from on-lot septic systems. The continuous scan along this indented shoreline was completed within three days.

2) To take discrete water samples for subsequent nutrient analysis only at those locations of alleged effluent plumes revealed by the leachate detector instrument.

3) To take bacteria samples for fecal coliform analysis from all moving surface tributaries or exceptionally high shoreline effluent plumes.

4) To make groundwater flow measurements in the shallow holes in the loose sand shoreline of the study areas.

5) To make visual observations relevant to sources of lake water degradation.

This survey was executed during the period from 17 through 20 November, 1979. Daytime temperatures ranged from 10° to 20°C. Sun and light air conditions prevailed the day of the continuous shoreline scan of the main body of water. The small isolated bays to the north of the road were surveyed on a day of high winds and rough water on the open lake.

2.1 Procedure

Marion County Lake was surveyed in continuous counter-clockwise direction starting on the eastern shore and concluding at the northwest corner of the eastern dam. The survey team consisted of two technicians and light-weight mobile survey gear. The basic equipment platform was a 12-foot aluminum boat with small outboard. The septic leachate detector instrument was securely lashed to a boat seat with shock cords and the water intake and exhaust tubes were extended over the starboard gunnel. A 12 vdc gel-cell battery provided electrical power to the instrument and submersible pump. The centrifugal water pump at the end of the 5-foot long metal tube intake wand drew near-bottom water through the instrument detector chamber and out a flexible plastic discharge tube from which retained samples could be taken.

A large ice chest held chilled water samples as well as supplies and maintenance gear. Groundwater specimens were drawn through a rugged stainless steel well-point sampler developed by K-V Associates, Inc. This 3/8 inch bore tube had 2½ foot threaded segments to accomodate different water and ground penetration depths. It was fitted with a slotted and pointed tip section. A 10-pound tubular steel hammer was used to drive the point into the bottom at depths of up to 2 feet. Water flowed easily at this depth but was impeded somewhat below this depth by finer, clayey sediments. Interstitial water was extracted via simple hand vacuum pump and large plastic receiving chamber. The captured groundwater could then be readily decanted apart from entrained sediment and bottled for later analysis. Such bottom samples accompanied each surface background sample and each significant plume discovery (none confirmed, in this case).

In summary, the two-man team walked or motored the boat around the lake within 15 feet of shore in shallow water. Background or plume samples were taken as required. Specific conductance of each sample was measured as the water was prefiltered and bottled. Relative fluorescence and conductivity were continouously plotted on separate analog strip recorders with positional cross references to the sewer planning map of the lake. Well water samples were taken from four lakeside homes along the western shore as a check for septic intrusion to drinking water sources.

2.2 Sample Handling

Both ground and surface water samples for nutrient analysis were retained in 250 ml clean plastic bottles. Each sample was prefiltered on the boat, .45 μm final-filtered and acidified for preservation at the end of the sampling day. The samples were held at 2° C or colder pending laboratory analysis at a later date.

Bacterial samples were captured in similar sterilized 250 ml plastic bottles and mailed to Kansas State Department of Health, Water Microbiology Section, Topeka, Kansas, for fecal coliform analysis.

2.3 Calibration

The shoreline scanning work day began with a calibration of the septic leachate instrument. Two standards were required: the first, a background sample drawn from an assumed unpolluted central portion of the lake; the second, a sample of local Marion municipal lagoon effluent. For the dynamic flow-through calibrations, the instrument was zero stabilized on 3 liters of recirculating background water, to which 2% (60 ml) of effluent was added. Signal deflections were equalized between the two channels and adjusted to about 50% of full scale. Marion treated effluent was also retained for later nutrient analysis.

2.4 Water Analysis

All water samples were analyzed by EPA standard methods for the following chemical constituents:

Nitrate nitrogen (combined NO_3-NO_2-N)
Ammonia nitrogen (NH_4-N)
Total phosphorous (TP)

3.0 PLUME LOCATIONS

A careful review of septic leachate detector charts and scanning fluorometer traces of retained water samples did not produce any definitive evidence of septic effluent leaching into the waters of Marion County Lake. The survey track and sampling locations are shown in Figures 3 and 6.

Municipal lagoon effluent from the City of Marion was used as a standard, representative of the baseline domestic wastewater of the area and its associated detergent whiteners and brighteners commonly used by the local residents. We examined for characteristic patterns of fluorescence and conductance in surface and groundwater samples drawn from Marion County Lake. The findings showed that although some isolated events were recorded during the continuous leachate shoreline scan, laboratory scanning fluorescence analysis of the associated water samples exhibited a consistent pattern, but one not identifiable with the pattern from lagoon effluent (Figure 4).

Elevated organic signals were observed at the ends of some coves (Bays 1, 2, 3, and 9S). The peaks contained fluorescing materials similar to degrading organic material, but did not contain the predominant UV fluorescent material characteristic of the local effluent (see Figure 4). It is possible that fecal material from cattle may be a source which reaches the coves and ponds during runoff.

The inflow of the tributary to the reservoir was found to carry a noticeable dissolved solid load, seen in segment 9. The phosphorus

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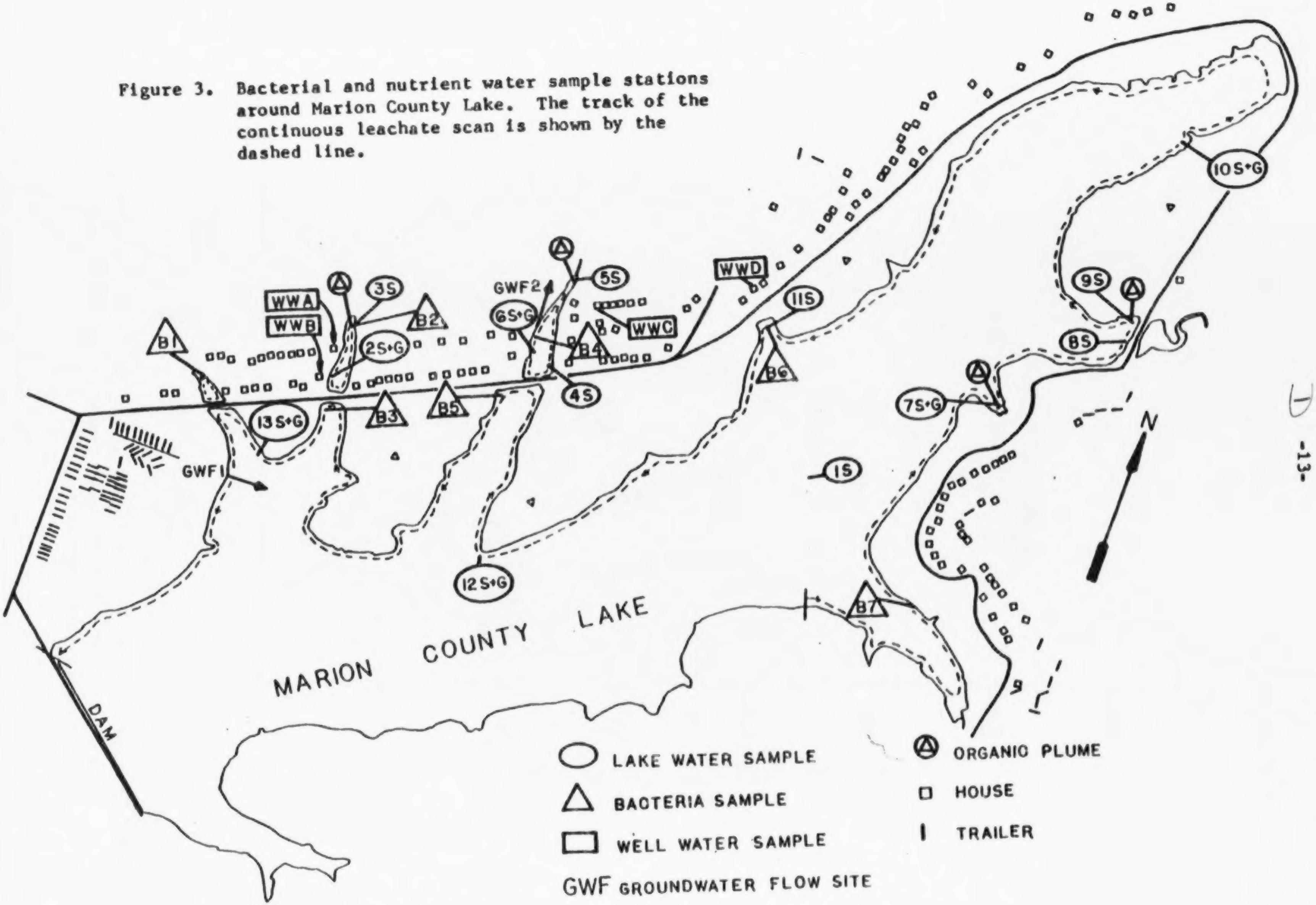
Figure 3. Bacterial and nutrient water sample stations around Marion County Lake. The track of the continuous leachate scan is shown by the dashed line.



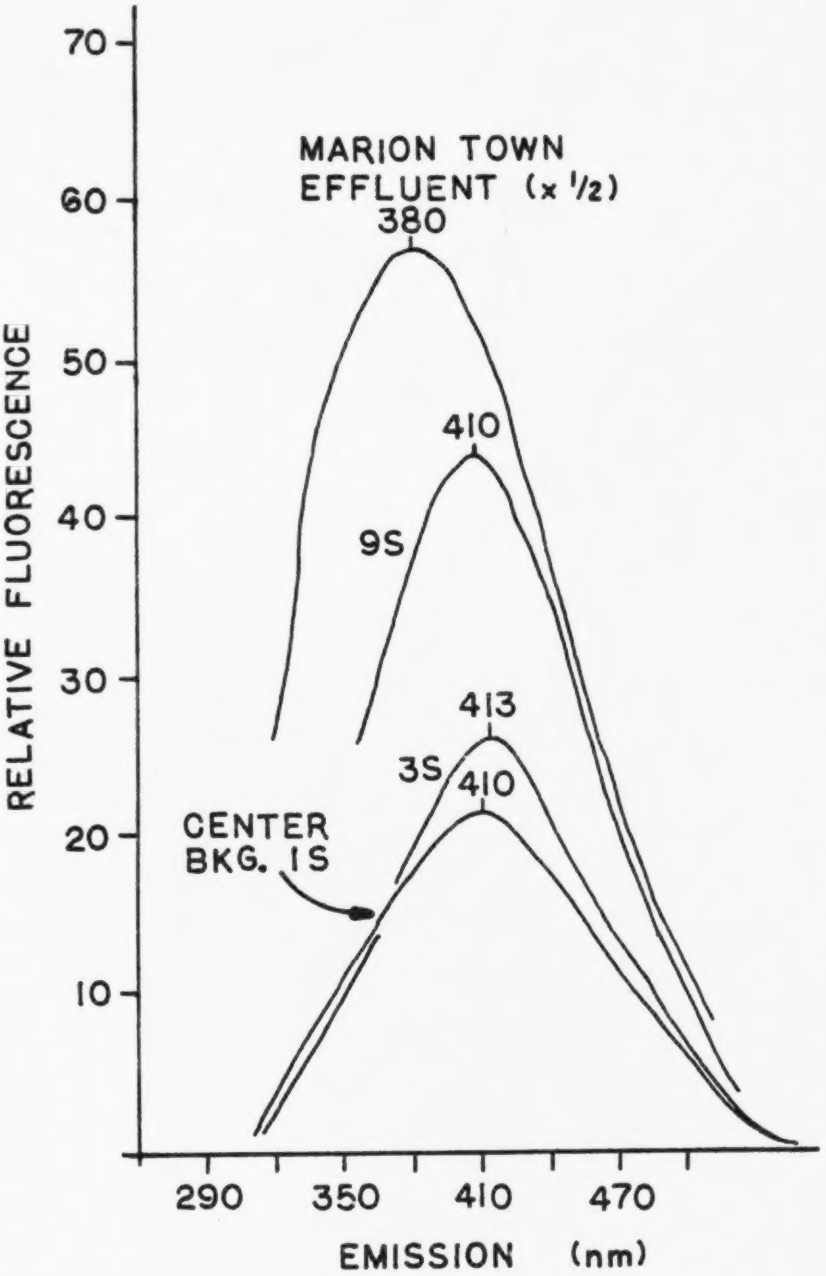


Figure 4. Surface water samples from lakeshore locations showing a distinctly different peak fluorescence emission (~ 410) than Marion town wastewater.

content of the inflow was 50% higher than the background surface water of the lake (sample 10S = .024 TP; sample 1S = .016 TP). Examination of the well water samples for UV fluorescence showed no traces of wastewater effluent.

4.0 NUTRIENT ANALYSIS

Completed analysis of the chemical content of 24 samples taken from around Marion County Lake are presented in Table 1. The numerical sampling code refers to the shoreline sampling locations as seen on the area map (see Figure 3). The symbol "S" refers to a surface water sample, the symbol "G" refers to a groundwater sample, and the symbol "WW" refers to a drinking water well sample. Virtually all groundwater samples were obtained with some difficulty from the clay bottoms of the coves.

The conductivity of the water samples as specific conductance (µmhos/cm) is given in the second column. The nutrient analysis for total phosphorus (TP), combined nitrate-nitrite nitrogen (NO_3-NO_2-N) and ammonia nitrogen (NH_4-N) are presented in the next three columns in parts-per-million (ppm-mg/l).

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Table 1. Analysis of surface water (S) and groundwater (G) samples taken around the periphery of Marion County Lake, Kansas.

Sample Number		Cond.	Total P ppm	NH_4-N ppm	NO_3-N * ppm	Comments
WWA	G		.004	.004	.042	well water
WWB	G		.004	.084	.009	"
WWC	G		.004	.016	.106	"
WWD	G		.005	.004	1.722	"
1	S	320	.016	.067	.022	
2	S	320	.024	.478	.026	
	G	400	.017	.079	.009	
3	S	320	.013	.067	.023	
4	S	310	.018	.144	.011	
5	S	320	.012	.003	.005	
6	S	320	.012	.043	.005	
	G	340	.016	.356	.017	
7	S	320	.012	.039	.009	
	G	1270	.010	2.201	.010	
8	S	315	.018	.077	.009	
9	S	340	.021	.060	.007	
10	S	320	.024	.039	.010	
	G	640	.007	.106	.308	
11	S	315	.014	.022	.008	
12	S	300	.012	.033	.007	
	G	430	.017	.183	.017	
13	S	300	.013	.033	.008	
	G	430	.026	.356	.033	
Marion effluent		1780	4.290	8.923	.153	

* combined NO_3-NO_2-N

5.0 GROUNDWATER FLOW PATTERNS

Recent investigations of the aquifer configuration and field determinations along the shoreline reveal little influence of groundwater inflow on Marion County Lake. Bowers (1979) reported field well pump test results which suggest that the principal aquifer resides in the fractured and jointed Towanda limestone at some depth below the lake bottom (Figure 5). The thinly fractured Gage shale overlying the Towanda limestone increases slightly in permeability with depth but is still much less permeable than the Towanda limestone. Current water levels in wells surrounding the lake indicate that the piezometric surface of the groundwater has adjusted to the lake level on the east shore but slopes downwards and away from the lake on the west shore. Inflow from the shoreline would be expected only from the eastern shore, based upon Bowers' observations. In agreement, the only erupting discharges found during the leachate survey were observed at Station 9 on the east side and with the creek inflow. These inflows appear to be shallow surface flows, restricted to stream drainage and not flows through the Gage shale. Even in the cove where samples 7S and G were taken, no inflow of interstitial water from lake bottom sediments was observed in the overlying surface water.

The upper portion of the Gage shale which forms the lake bottom acts as an aquitard with its low permeability. Bowers attributes the rise in piezometric surface to percolation or leakage from the lake (most probably from the deep lake bottom which intercepts more permeable lower shale layers) into the Towanda limestone aquifer.

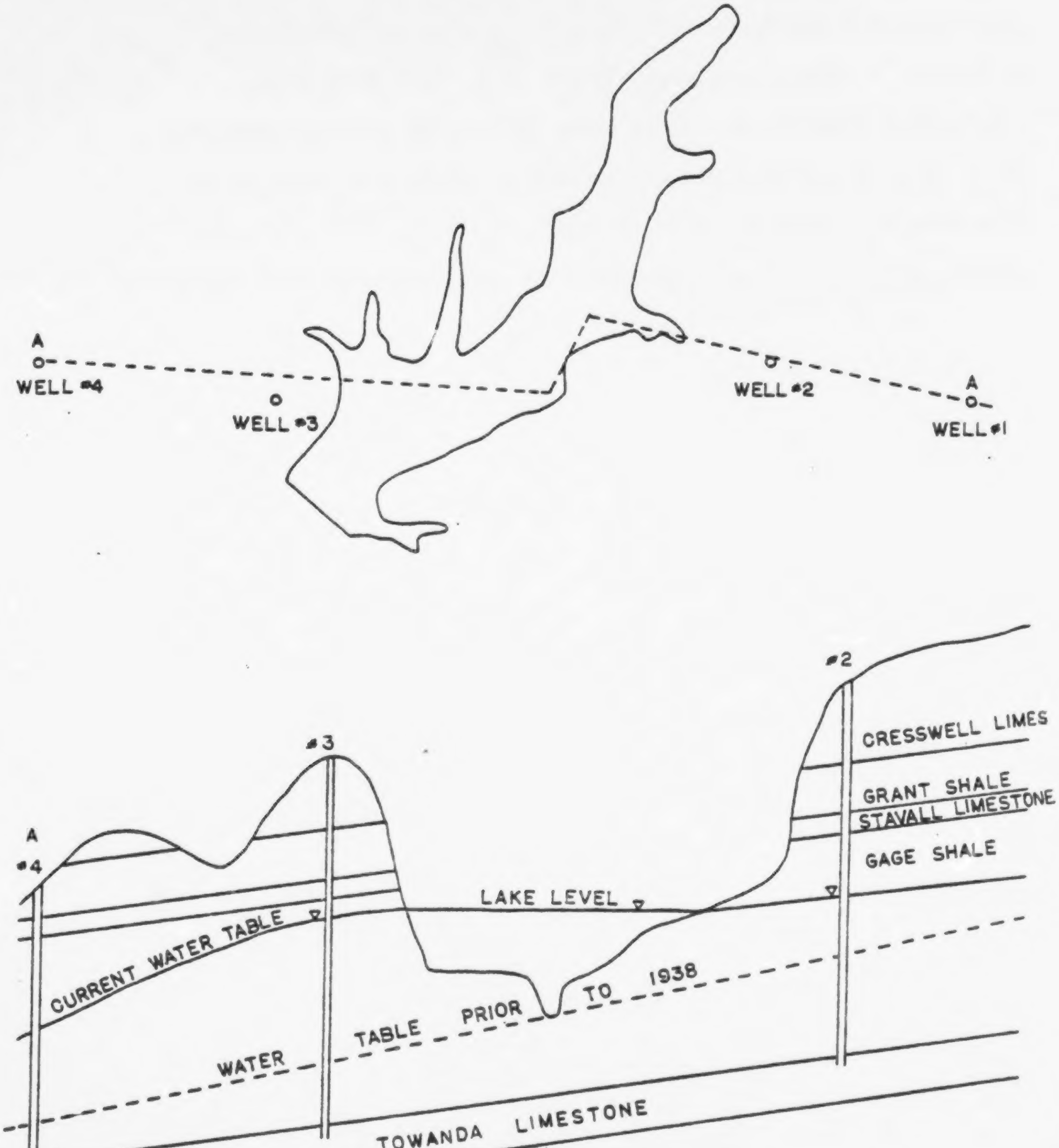


Figure 5. Projected groundwater (piezometric) heights developed by Bowers (1979) to show effects of lake creation. The crossection corresponds to transect A-A shown above.

Our limited field findings would support the concept of a low permeability upper lakeshore bottom of shale and silty clay soils. The dominant soils include Chase silty clay, Dwight silt, Irwin silty clay, Labette-Sogn complex, Sogn silty clay, Tully silty clay and Verdigris silt. We were unable to measure shallow groundwater movement in any more than two locations around the shore due to the difficult rock, gravel and clay conditions, although many more such sites were attempted.

6.0 COLIFORM LEVELS IN SURFACE WATERS

A series of water samples from around the lake was analyzed for fecal coliform content to confirm the presence of surface runoff or soil short-circuiting from malfunctioning systems. The membrane filter coliform count indicates the density of coliform organisms. Since these organisms may be of intestinal origin and are numerous in sewage, high numbers are indicative of sewage pollution with its possible hazards to public health. Here, the fecal coliform count was used as a more specific test of recent sewage pollution.

There was no record of high levels of coliform from historical sampling (Charles Penner, Marion County Sanitarian, December, 1979). All current samples contained low bacterial concentrations. Kansas water quality standards specify that fecal coliform numbers not exceed the geometric mean of 200 organisms per 100 ml of water for class A waters for recreational use and aquatic life. Therefore, all samples were well within State standards.

Coliform analysis was performed by the Kansas State Department of Health, Topeka, Kansas. See Table 2 for results and Figure 3 for sample locations.

Table 2. Bacterial content for shoreline samples, Marion County Lake.

Station Number	Fecal Coliform No./100 ml	Location
B1	<5	Back of first bay, west shore
B2	<5	Back of second bay, west shore
B3	<5	West side of Bay 2, south of road
B4	<5	West end of Bay 3, west shore
B5	<5	West side of Bay 3, south of road
B6	50	End of small cove, western shore
B7	5	Back of bay, eastern shore

7.0 CONCLUSIONS

A septic leachate survey was performed along the shoreline of Marion County Lake during November, 1979. The following results were obtained:

1) Septic leachate profiles along the shoreline recorded elevated organic signals only at the ends of isolated coves.

2) Analysis of the organic traces by UV-fluorescent scans indicated that the peaks contained fluorescing materials similar to degrading organic material, but did not contain the whitening agents characteristic of the local effluent. It is possible that fecal material from cattle may have been a probable source which reaches the coves from runoff from wading ponds or ditches upstream of the deposits.

3) Drinking well elevation records and the inability to obtain any meaningful measurements of groundwater inflow from shoreline deposits indicate that there is little groundwater inflow along the shoreline periphery.

4) The nutrient loadings from identified sources was quite low. Of the identified plumes of organic material, only two locations (2S and 9S) contained noticeably higher phosphorus contents than that of the background lake content (samples 1S, 10S, 12S). Sample 9S was obtained from an erupting organic plume of stream drainage removed from developed shoreline areas.

5) Bacterial analysis of cove surface water samples revealed fecal coliform concentrations well below class A standards for recreational use and aquatic life.

REFERENCES

Bowers, Norman, 1979. Kansas State University groundwater hydrology course term paper. Received via Region 7, U.S. Environmental Protection Agency, Kansas City, Missouri (RWS-30).

LRPC, 1977. Discussion of nutrient retention coefficients, Draft Report 6F2 from Phase II Nonpoint Source Pollution Control Program, Lakes Region Planning Commission, Meredith, New Hampshire.

①

APPENDIX

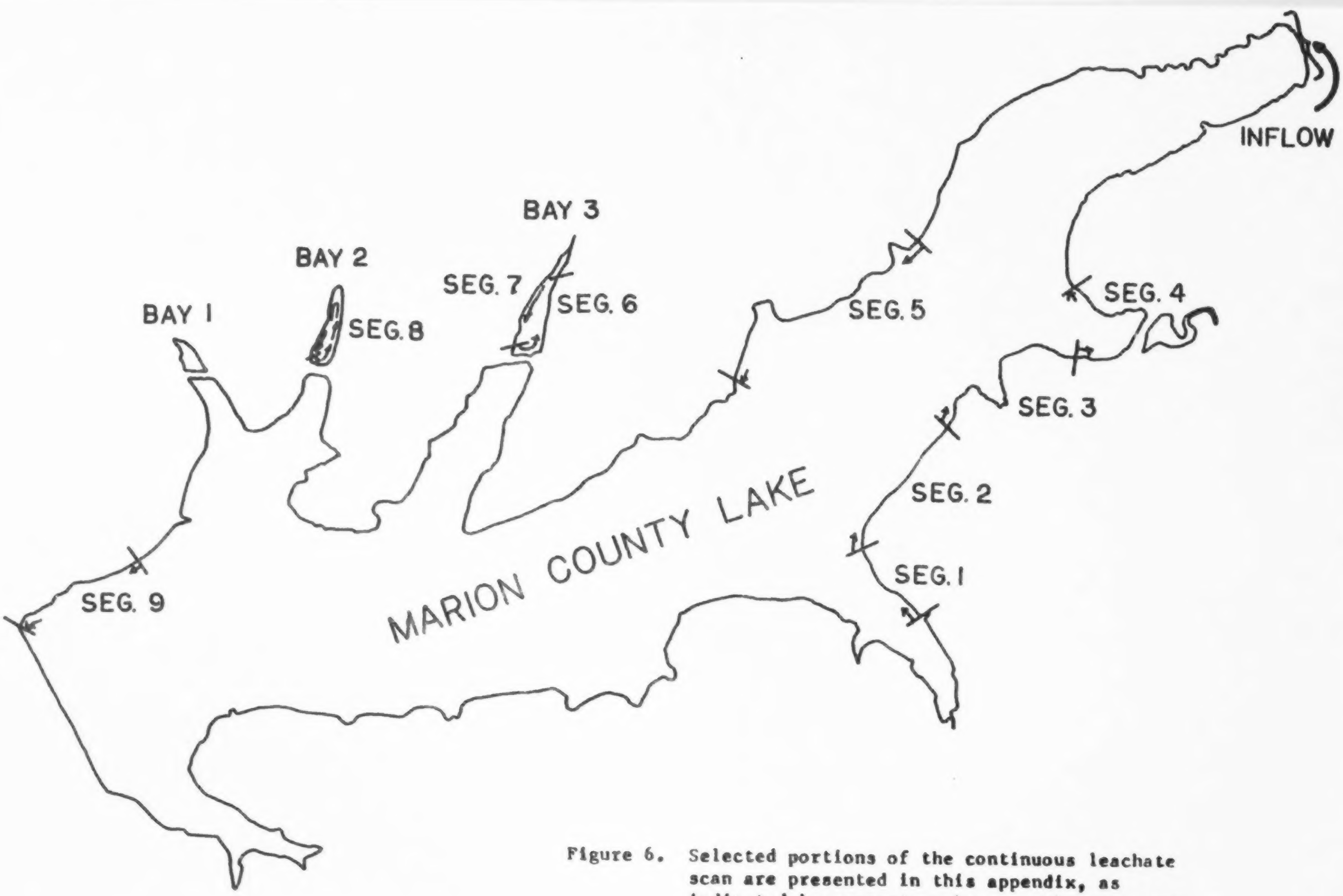
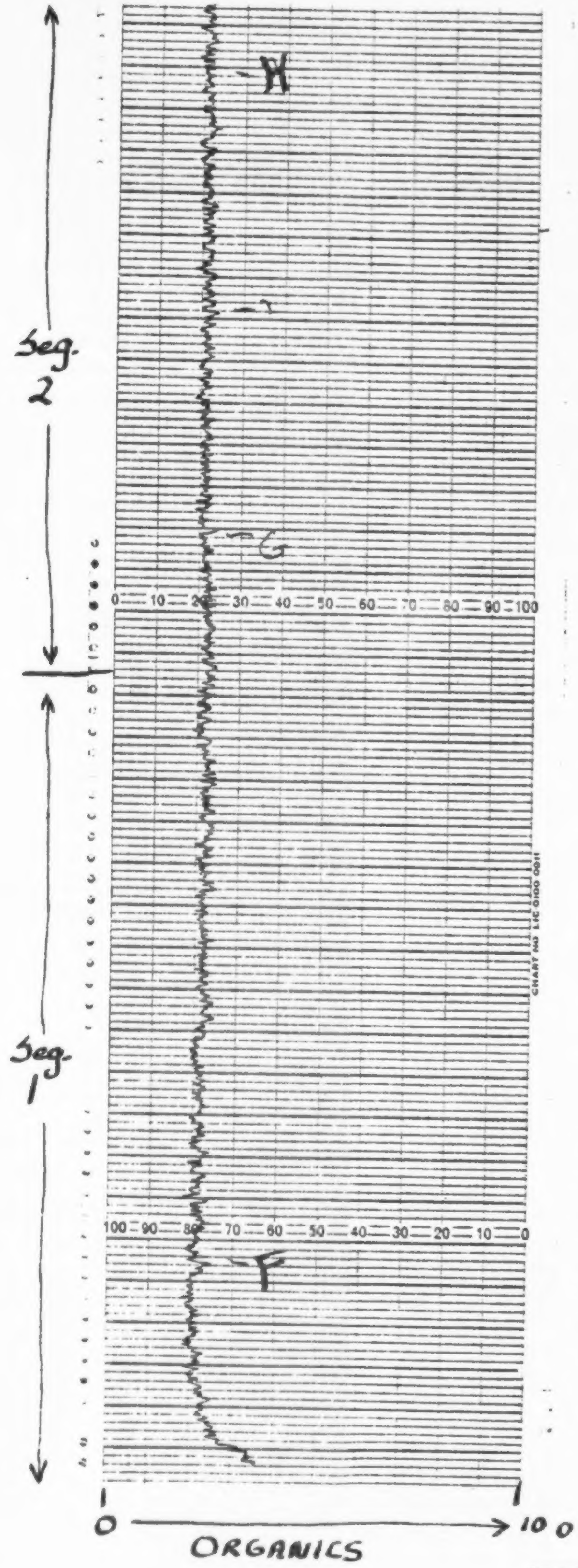


Figure 6. Selected portions of the continuous leachate scan are presented in this appendix, as indicated by segment numbers on the map. The scan consists of paired organic (fluorescence) and conductivity strip charts. The time scales are slightly different, but are cross-referenced.



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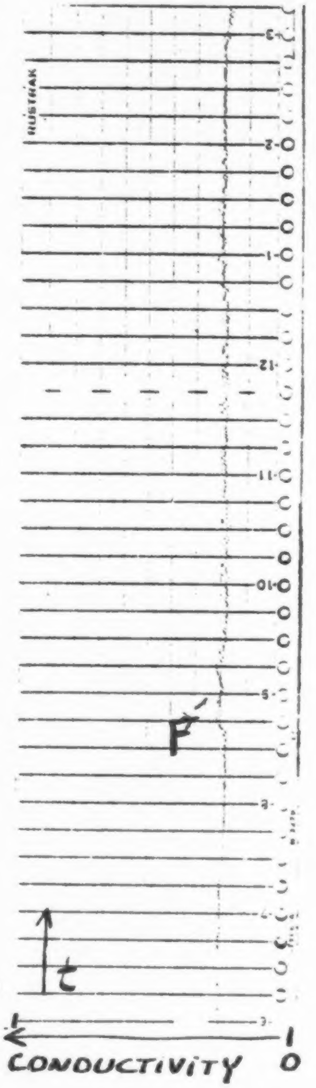

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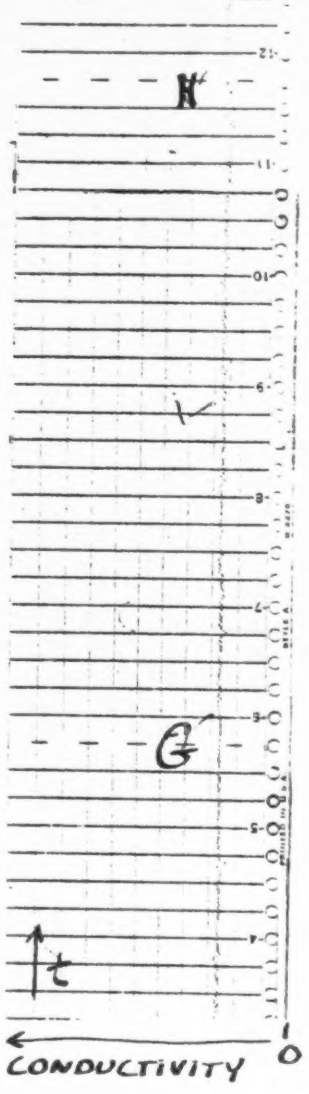

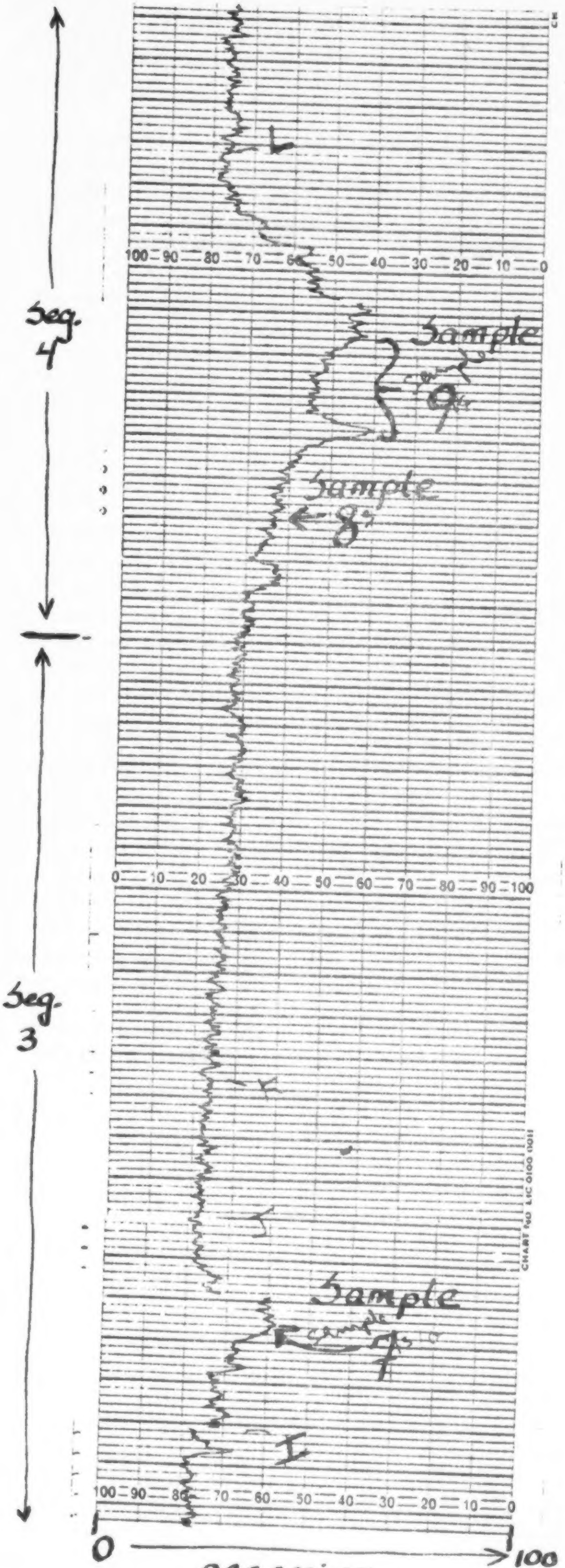

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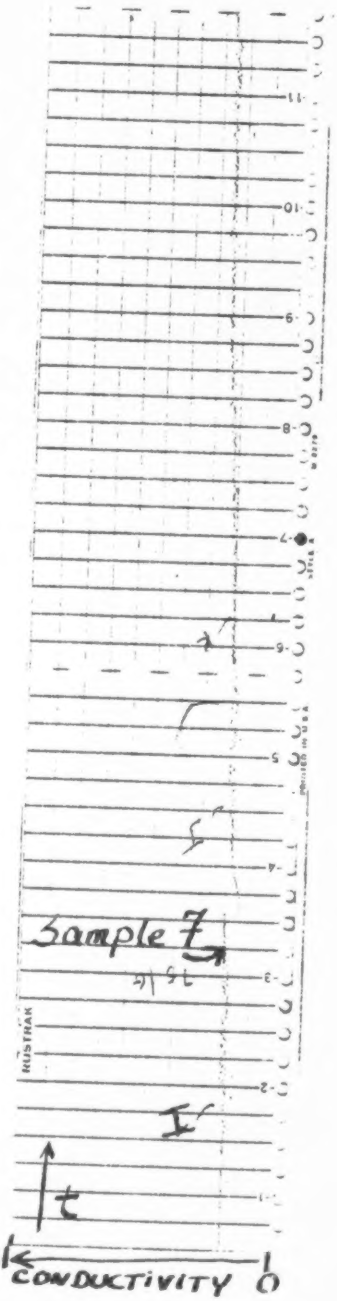

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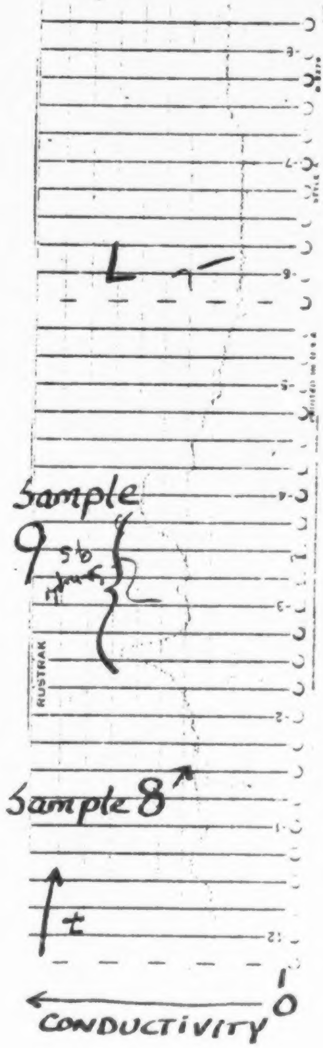

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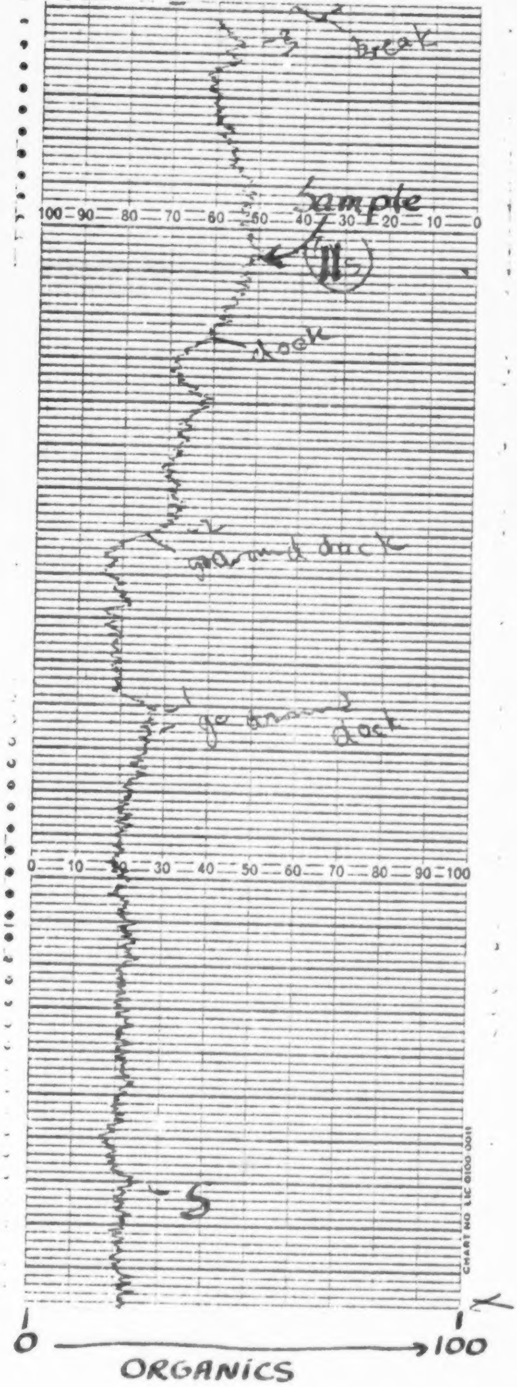

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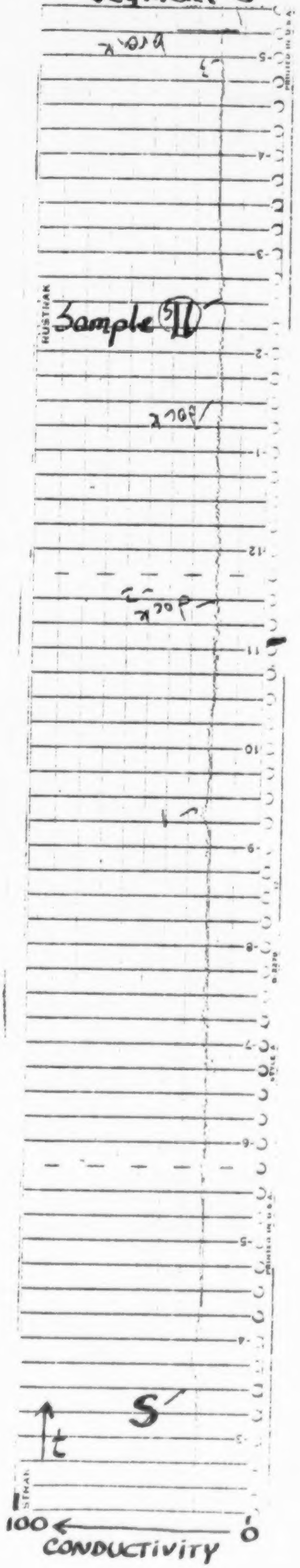
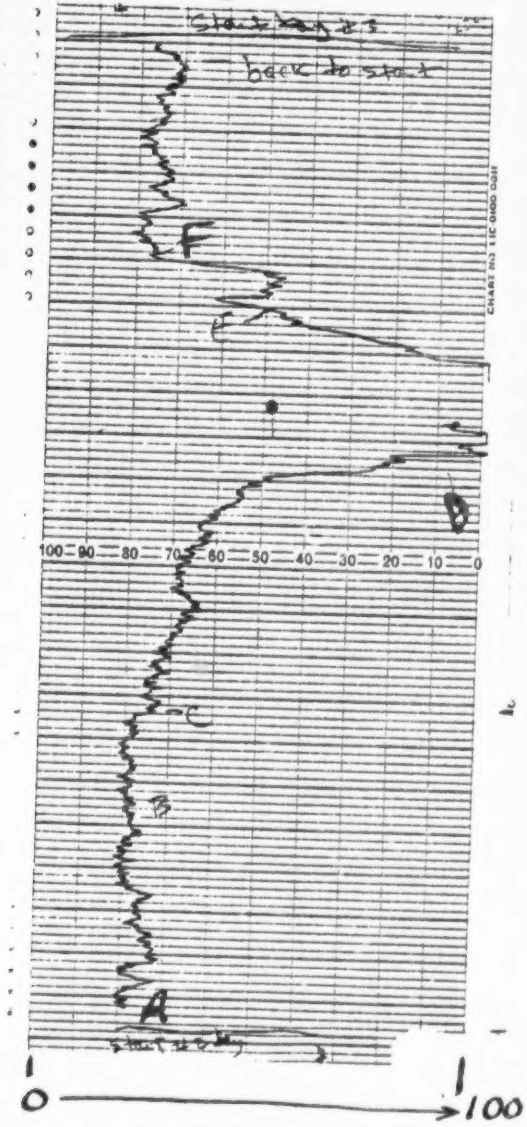


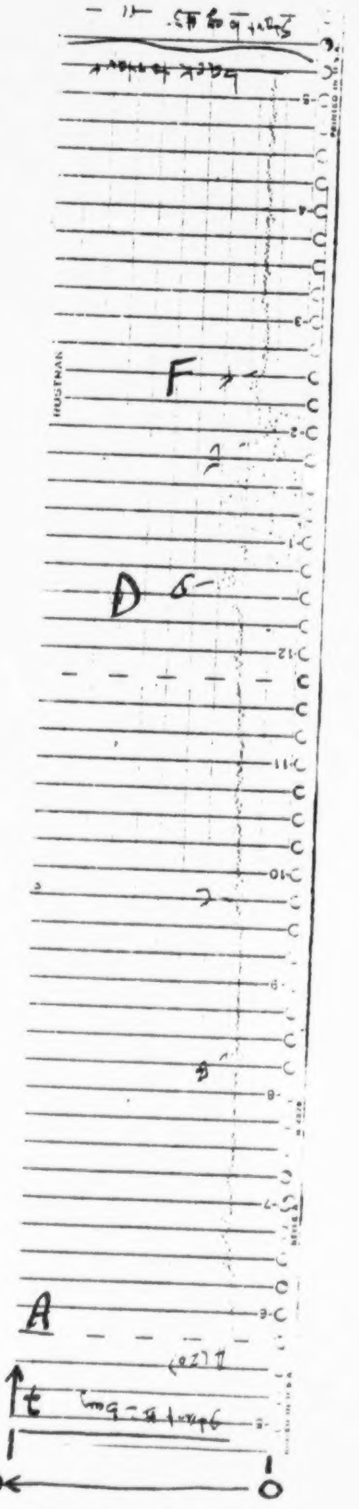
BAY #2

Segment 8

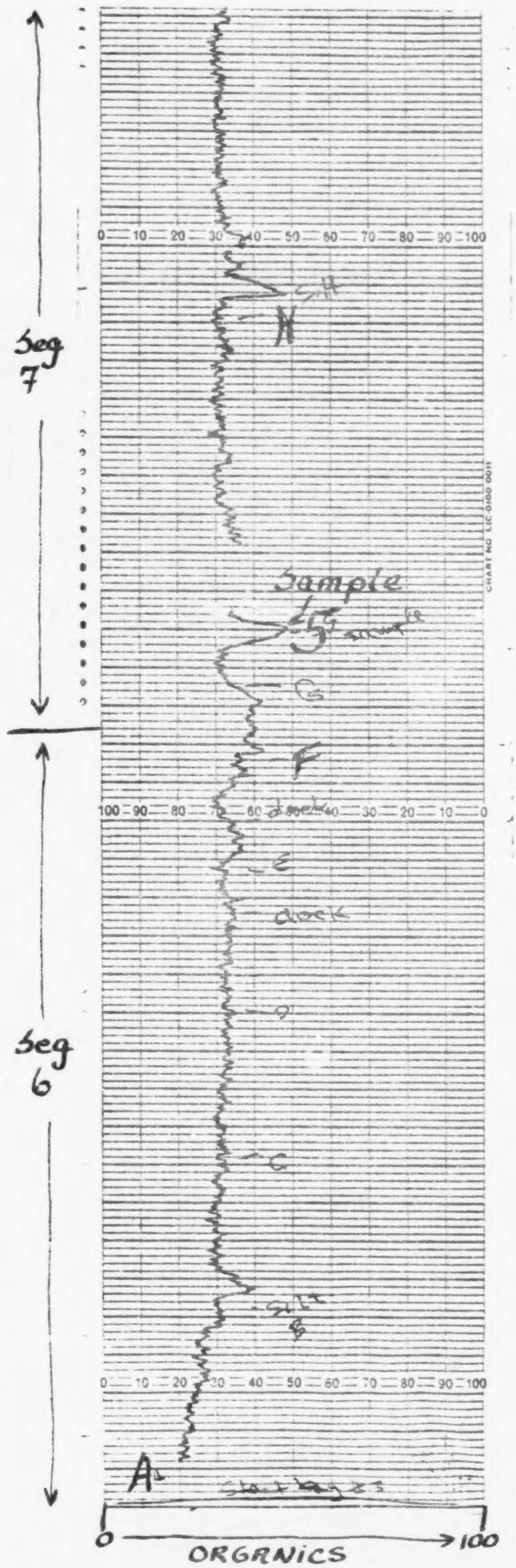


ORGANICS

Segment 8



CONDUCTIVITY



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D
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C
B
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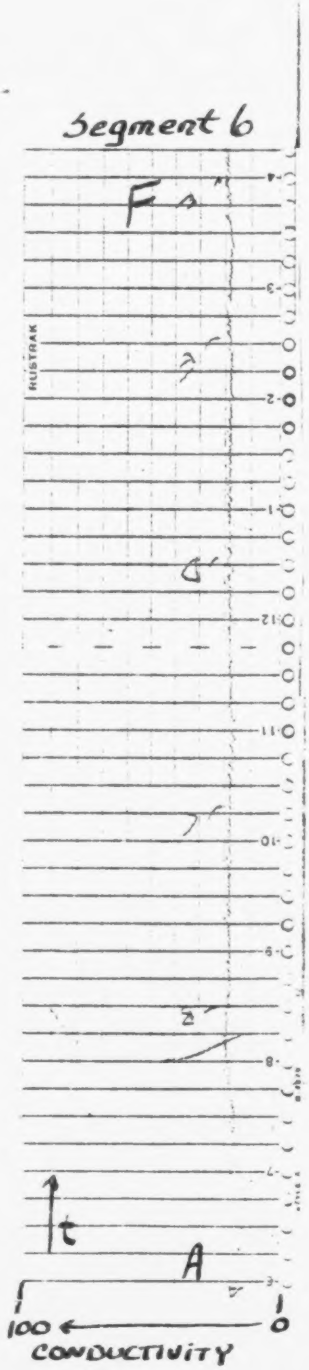
ORGANICS



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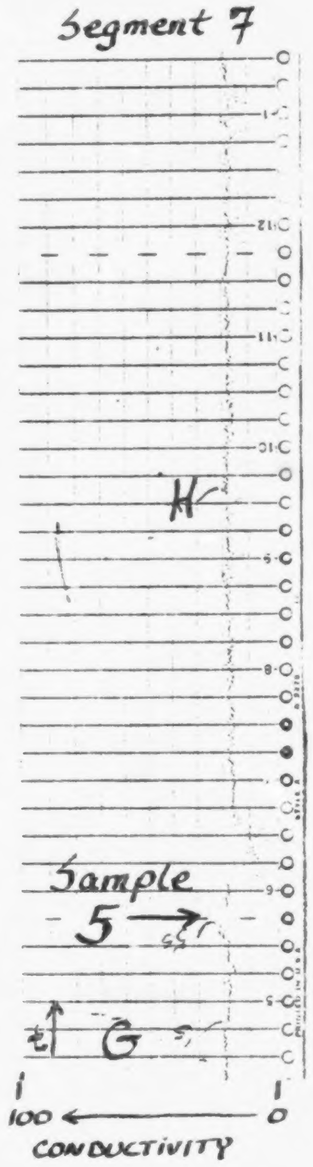

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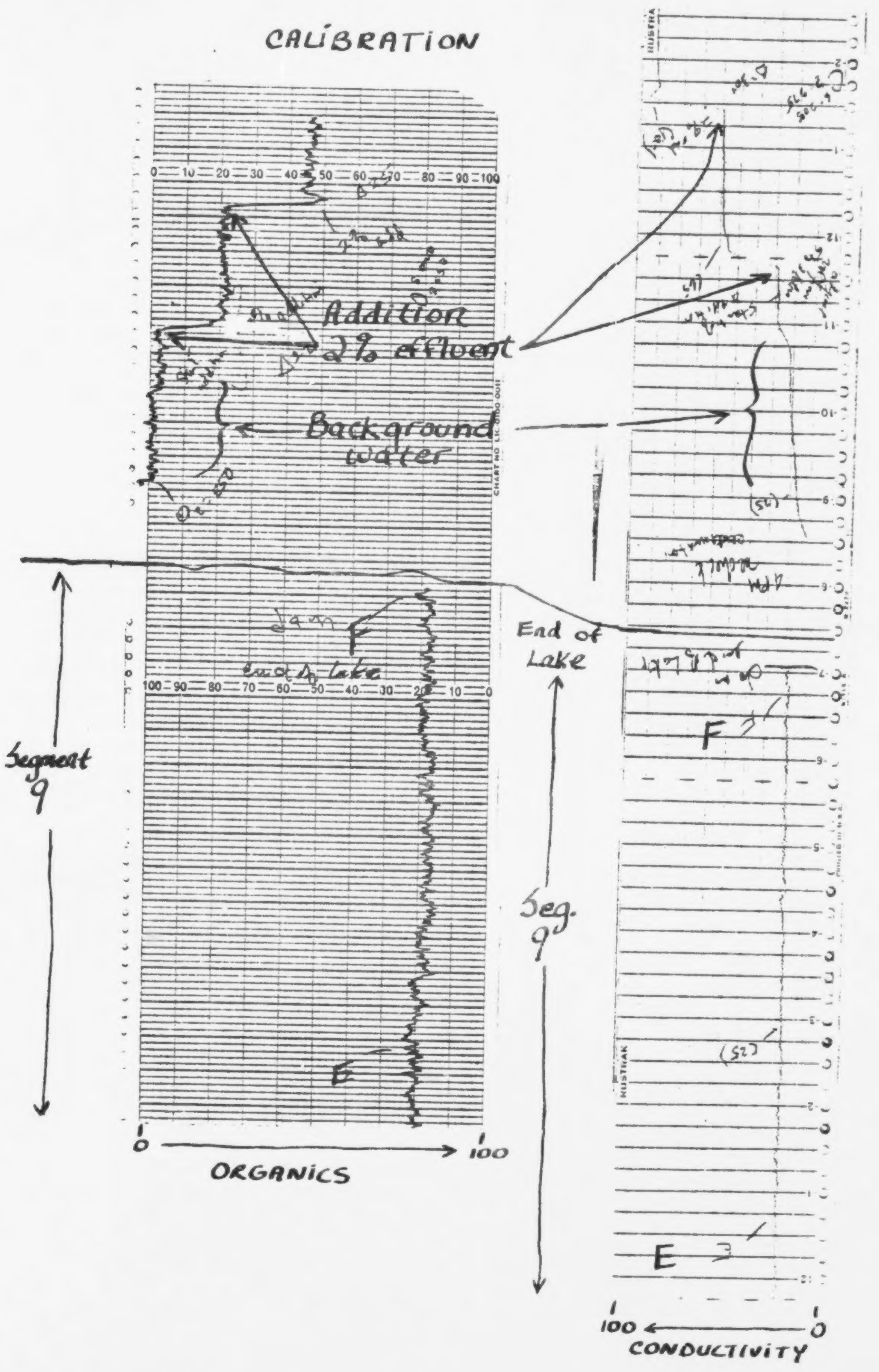

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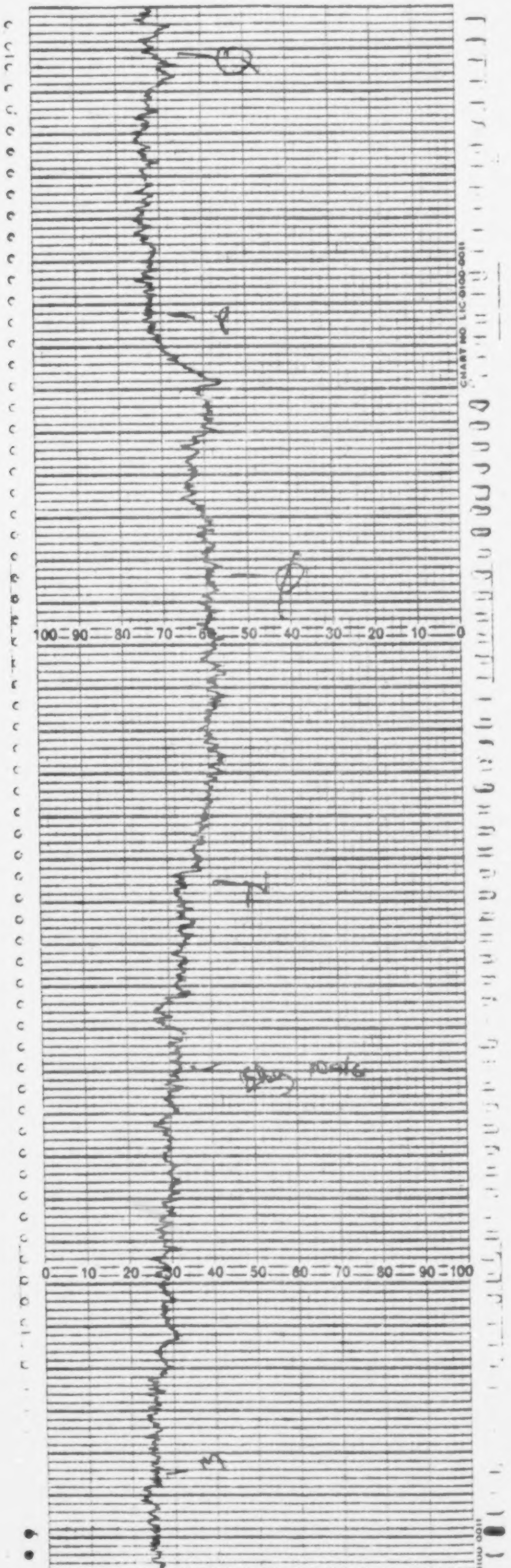
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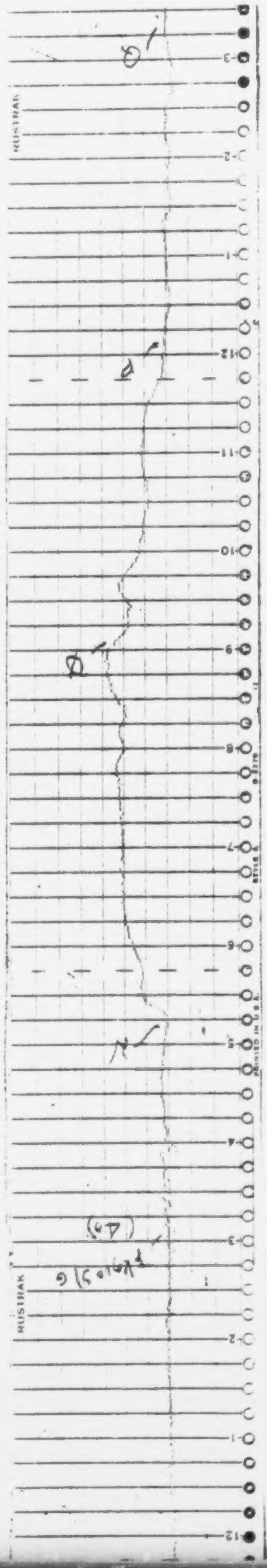
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APPENDIX E
COST EFFECTIVENESS

This appendix presents the parameters used in developing capital and operating cost estimates for the project alternatives presented in this EIS. Further, the tables at the end of this appendix present these parameters in the context of the present value calculations which are the basis of the cost-effective analysis.

1. General Assumptions

All design flows are based upon the population projections and flow rates shown in Table 6 in Chapter II. Population growth from the present day to the year 2000 was assumed to occur at a constant rate.

Unless otherwise noted in this appendix, all unit costs are identical to those used in the Facility Plan.

2. Centralized Treatment Alternatives

For both the Down-Sized Facility Plan Alternative and the Down-Sized Total Retention Lagoon Alternative, the following assumptions were made:

- Because capital and O&M costs for the final pumping station would vary depending upon the distance to be pumped to the treatment plant, costs for this station were included with those of the treatment system rather than the collection system.
- Because of the reduced design flows, capital costs for the remaining eight pump stations were estimated to be $18,000 each rather than $20,000.
- A 4"-diameter PVC force main (rather than 6") was proposed for transporting sewage from the final pump station to the treatment plant.

3. Downsized Facility Plan Alternative

   - Capital cost for the final pump station was estimated to be $25,000; O&M costs were estimated to be $1,400 per year.
   - Average daily flow was projected to be 28,000 gpd and peak day flow 69,500 gpd.
   - Average daily BOD load was projected to be 90 lb/day and peak day BOD 360 lb/day.
   - The Lake Improvement District's estimated share of the capital costs of the new City of Marion oxidation ditch treatment plant was based upon the additional flow and BOD load to be contributed by the District. Capital costs of the major plant components were allocated to the LID based upon the following percentages:

     Ditch - 60% flow, 40% BOD
     Rotors - 30% flow, 70% BOD
     Piping - 100% flow
     Sludge Disposal - 10% flow, 90% BOD
     Headworks - 100% flow
     Flow Measurement - 100% flow
   - The LID's share of operation and maintenance costs of the City's plant were allocated according to the following percentages:

     Labor - 53% flow, 47% BOD
     Repair & Maintenance - 53% flow, 47% BOD
     Power - 10% flow, 90% BOD

4. Downsized Total Retention Lagoon

   - Because local soils would require expensive preconstruction treatment to meet Kansas regulations, it was assumed that a membrane liner would be required to prevent seepage from the lagoon.
   - Dike earthwork and perimeter fencing were assumed to be proportional to the square root of the required lagoon surface area.

- Based upon discussions with local realtors, land costs were assumed to be $750 per acre.
- Operation and maintenance costs were assumed to be $9,600 for labor and $600 for parts and materials per year.
- Capital cost for the final pump station was estimated to be $20,000; O&M costs were estimated to be $800 per year.

5. No-Action Alternative

Future costs for this alternative were based on the premise that septic tank system failures and holding tank installations would continue at the same rates that have occurred since 1973, when the Marion County Sanitary Code was put into effect. These rates are:

- Septic tank failures will occur at the rate of one per year.
- Failed septic tanks will be repaired at the rate of 0.28 per year.
- Failed septic tanks will be replaced with holding tanks at the rate of 0.28 per year.
- Other septic tanks will be replaced by holding tanks at the rate of 0.71 per year.
- Holding tanks will be installed on new lots at the rate of 1.28 per year.
- All units presently using privies will be converted to holding tanks at the rate of 0.45 per year.
- Holding tanks will have 1250 gallon capacity, but will be emptied when reaching the 1100 gallon level.
- Each permanent household septic tank will be pumped out once every four years.
- Each seasonal household septic tank will be pumped out once every five years.
- Holding tank pumpout costs will increase from the present $40 to $47, based upon a projected increase from $3 to $10 in the dump charge at the new City of Marion plant.
- Based upon discussions with local contractors, capital costs for new holding tanks were assumed to be $700.

6. Limited On-Site Systems Alternative

The same assumptions used for the No-Action Alternative apply to this alternative, with the following exceptions:

- All presently-failing septic tanks will be replaced with holding tanks
- Because of increased inspection efforts, all septic tank systems failing in the future will be detected and replaced with holding tanks
- 1500 gallon tank truck operating times were assumed to be 60 minutes for pump-out, 30 minutes for dumping, and 10 minutes for travel time to and from the treatment plant
- 4500 gallon tank truck operating times were assumed to be 60 minutes per pump-out, 15 minutes between pumpouts, 45 minutes for dumping, and 10 minutes travel time to and from the treatment plant
- The 1500 gallon tank truck can pump out one holding tank or septic tank per trip
- The 4500 gallon tank truck can pump out four holding tanks or septic tanks per trip
- Truck O&M was assumed to be $0.30 per mile
- Labor was assumed to cost $15.00 per hour
- Based upon estimates provided by Moser and Associates, dumping charges at the new plant will be $10 per thousand gallons

7. Detailed Present Value Calculations

The tables which follow show the development of the present value of each project alternative. They list the design elements and cost factors from which capital and operating cost estimates were derived, and detail the steps taken to convert these estimates to present value.

TABLE E-1
PRESENT VALUE
ALTERNATIVE 1 - NO ACTION

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES[1]	
TREATMENT			
A. Capital Costs	0		0
B. Salvage Values	0		(0)
C. Annual Operation & Maintenance Costs			
Replace failing systems with holding tanks	2.75 tanks/yr @ $700/tank	1,900	
Replace failing systems with septic tanks	0.45 tanks/yr @ $1,100/tank	500	
Pumpouts	1870/yr @ $47/pumpout	87,900	
Septic tank leach field repair	0.28 failure/yr @ $200/repair	100	
Sub-total		90,400	
Total present value sum	20 yrs at 7.125% discount		948,500
TOTAL PRESENT VALUE			948,500
EQUIVALENT ANNUAL VALUE			90,400

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[1] Rounded to the nearest $100

TABLE E-2
PRESENT VALUE
ALTERNATIVE 2 - FACILITY PLAN PROPOSED PROJECT

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES[1]	
COLLECTION			
A. Capital Costs			
Sewer system	see Facility Plan, pg. 23	461,875	
Engineering & adminstrative	see Facility Plan, pg. 23	115,125	
Service connections	see Facility Plan, pg. 28	69,150	
Total present value			646,200
B. Salvage Values			
Sewer system	see R&G[2] letter of 8/31/79, pg. 18	(215,960)	
Total present value	discount at 7.125% over 20 yrs.		(54,500)
C. Annual O & M Costs			
Average annual O & M	see R&G letter of 8/31/79, pg. 19	5,000	
Total present value sum	20 yrs. at 7.125% discount		52,500
D. Total Present Value of Collection Costs			644,200
E. Equivalent Annual Value of Collection Costs			61,400

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[1] Rounded to the nearest $100

[2] Reiss and Goodness Engineers

TABLE E-2 (Continued)

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES	
TREATMENT			
A. Capital Costs			
Force main (transmission system)	see Facility Plan, pg. 21	61,800	
Engineering & adminstrative	see Facility Plan, pg. 21	15,400	
LID share of regional treatment plant	see R&G letter of 8/31/79, pg. 15	106,100	
Total present value			183,000
B. Salvage Values			
Force main	see R&G letter of 8/31/79, pg. 15	(60,600)	
LID share of regional treatment plant	see R&G letter of 8/31/79, pg. 15	(25,300)	
Sub-total		(85,900)	
Total present value	discount at 7.125% over 20 yrs.		(21,700)
C. Annual O & M Costs			
Average annual O & M	see R&G letter of 8/31/79, pg. 15	4,700	
Total present value sum	20 yrs. at 7.125% discount		49,300
D. Total Present Value of Treatment Costs			210,900
E. Equivalent Annual Value of Treatment Costs			20,100
TOTAL PRESENT VALUE			855,100
EQUIVALENT ANNUAL VALUE			81,500

TABLE E-3
PRESENT VALUE
ALTERNATIVE 3 - DOWN-SIZED FACILITY PLAN
PROPOSED PROJECT

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES[1]
COLLECTION		
A. Capital Costs		
Sewer system		
8" sanitary sewer pipe	12,525 l.f. @ $6/l.f.=75,200	
8" ductile iron, class 50	300 l.f. @ $14/l.f.=4,200	
12" concrete encasement	950 l.f. @ $14/l.f.=13,300	
0'-6' trench & backfill	11,145 l.f. @ $2/l.f.=22,300	
6'-8' trench & backfill	1,045 l.f. @ $2.50/l.f.=2,600	
8'-10' trench & backfill	485 l.f. @ $3.25/l.f.-1,600	
10'-12' trench & backfill	150 l.f. @ $4/l.f.=600	
manholes, constructed	271 l.f. @ $90/l.f.=24,400	
drop connections	4 each @ $350/each=1,400	
simplex grinder pumps, complete	8 each @ $3,000/each=24,000	
standby grinder pump with spare cutter impeller	3 each @ $1,000/each=3,000	
rock excavation	1,100 c.y. @ $40/c.y.=44,400	
duplex grinder pump, complete	2 each @ $5,000/each=10,000	
factory built pump station	8 each @ $18,000/each=144,000	
1½" PVC force main	6,355 l.f. @ $2.75/l.f.=17,500	
4" PVC force main	6,390 l.f. @ $4.50/l.f.=28,800	
4" x 8" service branch connection	223 each @ $25/each=5,600	
2" air release valve	3 each @ $200/each=600	
1" air release valve	2 each @ $150/each=300	
asphalt removal & replacement	150 s.y. @ $15/s.y.=2,300	
Sub-total, sewer system		426,100

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[1] Rounded to the nearest $100

TABLE E-3 (Continued)

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES	
Engineering & administrative	25% of sewer system cost	106,500	
Service connections			
connections to user's plumbing	217 each @ $50/each=10,900		
4" service line with trench and backfill	14,100 l.f. @ $4/l.f.-56,400		
Sub-total, service connections		67,300	
Total present value			599,900
B. Salvage Values			
Sewer system			
8" sanitary sewer pipe	3/5 of cost = 45,100		
8" ductile iron pipe	3/5 of cost = 2,500		
1½" PVC force main	3/5 of cost = 10,500		
4" PCV force main	3/5 of cost = 17,300		
Sub-total, sewer system		(75,400)	
Total Present value	discount at 7.125% over 20 yrs.		(19,000)
C. Annual O & M Costs			
Average annual O & M	see R&G[2] letter of 8/31/79, pg. 19	5,000	
Total present value sum	20 yrs. at 7.125% discount		52,500
D. Total Present Value of Collection Costs			633,400
E. Equivalent Annual Value of Collection Costs			60,400

[2] Reiss and Goodness Engineers

TABLE E-3 (Continued)

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES	
TREATMENT			
A. Capital Costs			
Force main (transmission system)			
4" PVC force main	10,100 l.f. @ $4.50/l.f.=45,500		
2" air release valve	1 each @ $200/each=200		
tie to inlet structure	1 l.s. @ $1,000/l.s.=1,000		
factory built lift station	1 l.s. @ $25,000/l.s.=25,000		
Sub-total, force main		71,700	
Engineering & adminstrative	25% of transmission system cost	17,900	
LID share of regional treament plant	based on % contribution of LID to wastewater flow and BOD loading	65,000	
Total present value			154,600
B. Salvage Values			
Force main			
4" PCV force main	3/5 of cost = 27,300		
2" air release valve	3/5 of cost = 120		
tie to inlet structure	3/5 of cost = 600		
Sub-total, force main		(28,020)	
LID share of regional treatment plant	3/5 of LID share of cost	(7,000)	
Sub-total		(35,000)	
Total Present value	discount at 7.125% over 20 yrs		(8,800)

TABLE E-3 (Continued)

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES	
C. Annual O & M Costs			
Average annual O & M			
lift station power	based on operating 7.2 hrs/day at 7.94.Kw hr = 150		
lift station maintenance	3% of capital cost/yr = 750		
force main maintenance	1% of capital cost/yr = 490		
LID share of regional plant costs	based on % contribution of LID to w.w. flow & BOD load = 2,930		
Sub-total, average annual O&M		4,300	
Total present value sum	20 yrs. at 7.125% discount		45,100
D. Total Present Value of Treatment Costs			190,900
E. Equivalent Annual Value of Treatment Costs			18,200
TOTAL PRESENT VALUE			824,300
EQUIVALENT ANNUAL VALUE			78,600

TABLE E-4
PRESENT VALUE
ALTERNATIVE 4 - DOWN-SIZED TOTAL RETENTION LAGOON

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES[1]	
COLLECTION			
A. Capital Costs			
Sewer system	same as Alternate 3	426,100	
Engineering & adminstrative	25% of sewer system cost	106,500	
Service connections	same as Alternate 3	67,300	
Total present value			599,900
B. Salvage Values			
Sewer system	same as Alternate 3	(75,400)	
Total present value	discount at 7.125% over 20 yrs.		(19,000)
C. Annual O & M Costs			
Average annual O & M	see R&G[2] letter of 8.31.79, pg. 19	5,000	
Total present value sum	20 yrs. at 7.125% discount		52,500
D. Total Present Value of Collection Costs			633,400
E. Equivalent Annual Value of Collection Costs			60,400

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1 Rounded to the nearest $100
2 Reiss & Goodness Engineers

TABLE E-4 (Continued)

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES	
TREATMENT			
A. Capital Costs			
Lagoon			
soil excavation	70,568 c.y. @ $1.10/c.y. = 77,600		
rock excavation	70,654 c.y. @ $5/c.y.=353,300		
land	20 acres @ $750/acre=15,000		
inlet wier	1 each @ $1,500/each=1,500		
pond transfer	3 each @ $1,700/each=5,100		
fence	3,732 l.f. @ $2.75/l.f.-10,300		
force main	2,434 l.f. @ $4.50/l.f.=11,000		
lift station	1 each @ $20,000/each=20,000		
Sub-total, lagoon		493,800	
Engineering & adminstrative	25% of lagoon cost	123,500	
Total present value			617,300
B. Salvage Values			
Land	appreciates 3% annually, compounded over 20 yrs.	(27,100)	
Force main	3/5 of cost	(6,600)	
Sub-total		(33,700)	
Total present value	discount at 7.125% over 20 yrs.		(8,500)

TABLE E-4 (Continued)

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES	
C. Annual O & M Costs			
Average annual O & M			
lift station maintenance	3% of capital cost/yr = 600		
lift station repairs	S&P[3] estimate = 600		
force main maintenance	1% of capital cost/yr = 110		
labor	1.75 hrs/day x 365 @ $15/hr = 9,581		
Sub-total, O&M		11,000	
Total present value sum	20 yrs at 7.125% discount		115,400
D. Total Present Value of Treatment Costs			724,200
E. Equivalent Annual Value of Treatment Costs			69,000
TOTAL PRESENT VALUE			1,357,600
EQUIVALENT ANNUAL VALUE			129,400

[3] Sverdrup & Parcel and Associates, Inc.

TABLE E-5
PRESENT VALUE
ALTERNATIVE 5 - LIMITED PUBLIC ON-SITE SYSTEMS

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES[1]	
TREATMENT			
A. Capital Costs			
Pumpout trucks			
truck #1	1980 price = 80,000; see ref. 73		
replacement for truck #1	P.V. of 1990 price = 40,200; ref. 73		
truck #2	P.V. of 1988 price = 46,100; ref. 73		
replacement for truck #2	P.V. of 1998 price = 23,200; ref. 73		
Sub-total, pumpout trucks		189,500	
Replace holding tanks	5 tanks @ $700/tank	3,500	
Engineering & adminstrative	25% of capital cost P.V.'s above	48,300	
Total present value			241,300
B. Salvage Values			
Pumpout truck #2	P.V. of 8/10 of 1998 cost		(16,200)
C. Annual O & M Costs			
Dumping, repair, labor, gas	based on uniform cost gradients; see ref. 74	634,000	
Insurance	P.V. over 20 yrs. of $500/yr/truck	7,500	
Installation of holding tanks	P.V. over 20 yrs of 3.45 tanks/yr @ $700/tank	25,300	

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[1] Rounded to the nearest $100

TABLE E-5 (Continued)

PROJECT ELEMENT	COST FACTORS	PRESENT VALUES	
C. Annual O & M Costs (Continued)			
Installation of septic tanks	P.V. over 20 yrs. of 0.45 tanks/ yr. @ $1,100/tank	5,100	
Total present value			671,900
TOTAL PRESENT VALUE			897,000
EQUIVALENT ANNUAL VALUE			85,500